

INTERNATIONAL STANDARD

**ISO/IEC
14496-1**

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AMENDMENT 8
2004-10-01

Information technology — Coding of audio-visual objects —

Part 1: Systems

**AMENDMENT 8: New ObjectTypeIndication
code points**

*Technologies de l'information — Codage des objets audiovisuels —
Partie 1: Systèmes*

AMENDEMENT 8: Points de code "ObjectTypeIndication" nouveaux

Reference number
ISO/IEC 14496-1:2001/Amd.8:2004(E)



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Amendment 8 to ISO/IEC 14496-1:2001 was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Introduction

This Amendment specifies a new Object Type Indication Table to reflect standardization of new streams.

Information technology — Coding of audio-visual objects —

Part 1: Systems

AMENDMENT 8: New ObjectTypeIndication code points

Table 8

Change Table 8 in subclause 8.6.6.2 as follows:

- Add ObjectType 0x07 for Synthesized Texture Stream
- Add ObjectType 0x08 for Streaming Text Stream
- Reserve 0x6D for registration authority
- Reserve 0x6E - 0x9F for ISO use
- Reserve 0xA0 - 0xBF for registration authority
- Reserve 0xC0 - 0xFE for user private

The objectTypeIndication table is provided below.

Table 8 — ObjectTypeIndication Values

| Value | ObjectTypeIndication Description |
|--------------|---|
| 0x00 | Forbidden |
| 0x01 | Systems ISO/IEC 14496-1 ^a |
| 0x02 | Systems ISO/IEC 14496-1 ^b |
| 0x03 | Interaction Stream |
| 0x04 | reserved for ISO use |
| 0x05 | AFX Stream |
| 0x06 | Font Data Stream |
| 0x07 | Synthesized Texture Stream |
| 0x08 | Streaming Text Stream |
| 0x09-0x1F | reserved for ISO use |
| 0x20 | Visual ISO/IEC 14496-2 ^c |
| 0x21-0x3F | reserved for ISO use |
| 0x40 | Audio ISO/IEC 14496-3 ^d |
| 0x41-0x5F | reserved for ISO use |
| 0x60 | Visual ISO/IEC 13818-2 Simple Profile |
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| 0x6A | Visual ISO/IEC 11172-2 |
| 0x6B | Audio ISO/IEC 11172-3 |
| 0x6C | Visual ISO/IEC 10918-1 |
| 0x6D | reserved for registration authority |
| 0x6E - 0x9F | reserved for ISO use |
| 0xA0 - 0xBF | reserved for registration authority |
| 0xC0 - 0xFE | user private |
| 0xFF | no object type specified ^e |

^a This type is used for all 14496-1 streams unless specifically indicated to the contrary. Scene Description scenes, which are identified with StreamType=0x03 (see Table 7), using this object type value shall use the BIFSConfig specified in 9.3.5.2.2 of this International Standard.

^b This object type shall be used, with StreamType=0x03 (see Table 7), for Scene Description streams that use the BIFSV2Config specified in 9.3.5.2.2 of this International Standard. Its use with other StreamTypes is reserved.

^c Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-2 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-2, Annex K.

^d Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-3 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-3, subpart 1, 6.2.1.

^e Streams with this value with a StreamType indicating a systems stream (values 1,2,3, 6, 7, 8, 9) shall be treated as if the ObjectTypeIndication had been set to 0x01.

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AMENDMENT 7
2004-08-15

Information technology — Coding of audio-visual objects —

Part 1: Systems

**AMENDMENT 7: Use of AVC (Advanced
Video Coding) in MPEG-4 systems**

Technologies de l'information — Codage des objets audiovisuels —

Partie 1: Systèmes

*AMENDEMENT 7: Utilisation du codage vidéo avancé dans les
systèmes MPEG-4*

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Introduction

The Advanced Video Coding (AVC), jointly developed by the ITU-T SG 16 VCEG (Video Coding Expert Group) and ISO/IEC JTC 1/SC 29/WG 11, offers not only increased coding efficiency and enhanced robustness, but also many features for the systems that use it. To enable the best visibility of, and access to, those features, and to enhance the opportunities for the interchange and interoperability of media, this standard specifies the usage of AVC within the ISO/IEC 14496-1 Framework (ISO/IEC 14496-1:2001 and its various amendments). This specification enables AVC video streams to:

- be used in conjunction with other media streams, such as audio; and
- be used in an MPEG-4 systems environment, if desired.

Information technology — Coding of audio-visual objects —

Part 1: Systems

AMENDMENT 7: Use of AVC (Advanced Video Coding) in MPEG-4 systems

Add the following to Clause 2 Normative references:

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding*

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

Insert the following definitions alphabetically:

AVC Parameter Set

either a sequence parameter set or a picture parameter set

NOTE This term is used to refer to both types of parameter sets.

AVC Access Unit

an access unit made up of NAL Units as defined in ITU-T Recommendation H.264 | ISO/IEC 14496-10 with the structure defined in 5.2.3 of ISO/IEC 14496-15

AVC Parameter Set Access Unit

an Access Unit made up only of sequence parameter set NAL units or picture parameter set NAL units having same timestamps to be applied

AVC Parameter Set Elementary Stream

an elementary stream made up only of AVC parameter set access units

AVC Video Elementary Stream

an elementary stream containing access units made up of NAL units for coded picture data

Add the following to Clause 5 Abbreviations and Symbols alphabetically:

| | |
|-----|--|
| AVC | Advanced Video Coding, ITU-T Recommendation H.264 ISO/IEC 14496-10 |
| HRD | Hypothetical Reference Decoder |
| IDR | Instantaneous Decoding Refresh |
| NAL | Network Abstraction Layer |
| SEI | Supplementary Enhancement Information |

Replace Table 6 with following table:

Table 6 - visualProfileLevelIndication Values

| Value | Profile | Level |
|--------------|--|--------------|
| 0x00-0x7E | defined in ISO/IEC 14496-2 Annex G | - |
| 0x7F | ISO/IEC 14496-10 Advanced Video Coding | - |
| 0x80-0xFD | defined in ISO/IEC 14496-2 Annex G | - |
| 0xFE | no visual profile specified | - |
| 0xFF | no visual capability required | |

NOTE — Usage of the value 0x7F indicates the use of any profile and level of ISO/IEC 14496-10 AVC. For the real profile and level numbers for ISO/IEC 14496-10 refer to the DecoderSpecificInfo.

NOTE — Usage of the value 0xFE indicates that the content described by this InitialObjectDescriptor does not comply to any visual profile specified in ISO/IEC 14496-2 or -10. Usage of the value 0xFF indicates that none of the visual profile capabilities are required for this content.

Replace Table 8 with the following table:

Table 8 — objectTypeIndication Values

| Value | ObjectTypeIndication Description |
|--------------|---|
| 0x00 | Forbidden |
| 0x01 | Systems ISO/IEC 14496-1 ^a |
| 0x02 | Systems ISO/IEC 14496-1 ^b |
| 0x03-0x1F | reserved for ISO use |
| 0x20 | Visual ISO/IEC 14496-2 |
| 0x21 | Visual ITU-T Recommendation H.264 ISO/IEC 14496-10 ^e |
| 0x22 | Parameter Sets for ITU-T Recommendation H.264 ISO/IEC 14496-10 ^e |
| 0x23-0x3F | reserved for ISO use |
| 0x40 | Audio ISO/IEC 14496-3 ^d |
| 0x41-0x5F | reserved for ISO use |
| 0x60 | Visual ISO/IEC 13818-2 Simple Profile |
| 0x61 | Visual ISO/IEC 13818-2 Main Profile |
| 0x62 | Visual ISO/IEC 13818-2 SNR Profile |
| 0x63 | Visual ISO/IEC 13818-2 Spatial Profile |
| 0x64 | Visual ISO/IEC 13818-2 High Profile |
| 0x65 | Visual ISO/IEC 13818-2 422 Profile |
| 0x66 | Audio ISO/IEC 13818-7 Main Profile |
| 0x67 | Audio ISO/IEC 13818-7 LowComplexity Profile |
| 0x68 | Audio ISO/IEC 13818-7 Scaleable Sampling Rate Profile |
| 0x69 | Audio ISO/IEC 13818-3 |
| 0x6A | Visual ISO/IEC 11172-2 |
| 0x6B | Audio ISO/IEC 11172-3 |
| 0x6C | Visual ISO/IEC 10918-1 |
| 0x6D - 0xBF | reserved for ISO use |
| 0xC0 - 0xFE | user private |
| 0xFF | No object type specified |

^a This object type shall be used for all streamTypes defined in ISO/IEC 14496-1 except IPMP streams.

^b Includes associated Amendment(s) and Corrigendum(a).

^c Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-2 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-2, Annex K.

^d Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-3 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-3, 6.2.1.

^e Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ITU-T Recommendation H.264 | ISO/IEC 14496-10 and are conveyed in the DecoderSpecificInfo as specified in this amendment, subclause 14.2.

Add the following after Clause 13:

14 Usage of ITU-T Recommendation H.264 | ISO/IEC 14496-10 AVC

14.1 SL packet encapsulation of AVC Access Unit

The definition of AVC Access Unit is specified in 7.4.1.2 of ITU-T Recommendation H.264 | ISO/IEC 14496-10. Following restrictions and recommendation are applied when it is encapsulated as an SL packet.

- Start Codes shall not be present in the stream. The field indicating the size of each following NAL unit shall be added before NAL unit. The size of this field is defined in DecoderSpecificInfo.
- SL packet whose randomAccessPointFlag in the header is set to '1' and subsequent SL packets shall carry access units that parameter sets required to decode are provided prior to their use.
- The Picture Timing SEI message that defines the timing information may be present in the video elementary stream, as this message contains other information than timing, and may be required for conformance testing of decoder. However, when it is encapsulated as SL packets, those time information carried by the Picture Timing SEI message shall not be used to decide decoding time or composition time of access unit. Timing information for decoding and composition shall be provided by SL packet header.
- It is recommended encapsulating one NAL unit in one SL packet when it is delivered over lossy environment.

14.2 Handling of Parameter Sets

14.2.1 Usage of DecoderSpecificInfo

Parameter Sets of AVC contents may be updated dynamically. However, DecoderSpecificInfo carrying Parameter Sets shall not be changed through the session. Parameter Sets carried in the DecoderSpecificInfo shall be updated by one of two way as follows:

- Sequence or Picture Parameter Set NAL units may be inserted in the video stream;
- A parameter set elementary stream, containing only parameter set access units, may be used to carry parameter sets separately from AVC video elementary stream. When the parameter set elementary stream is used, access units in AVC video elementary stream shall not carry parameter sets. The parameter sets shall be updated when the decoding time defined in the header of SL packet carrying those parameter sets is reached.

14.2.1.1 Decoder Specific Information

This subclause defines the `DecoderSpecificInfo` descriptor for an AVC elementary stream.

14.2.1.1.1 Syntax

```
aligned(8) class AVCDecoderSpecificInfo extends DecoderSpecificInfo : bit(8)
tag=DecSpecificInfoTag {
    AVCVideoConfigurationRecord config;
}
```

14.2.1.1.2 Semantics

The decoder specific information for an AVC stream contains an AVC video stream decoder configuration record, which is defined in ISO/IEC 14496-15 subclause 5.2.4.

`config` contains the decoder configuration record for the AVC elementary stream decoder configuration.

14.2.1.2 Object type indication

The DecoderConfigDescriptor shall set the value of streamtype equal to 0x04 for both AVC video elementary stream and the AVC parameter set elementary streams.

The DecoderConfigDescriptor for an AVC video elementary stream, possibly including in-line sequence or picture parameter sets, shall set objectTypeIndication to be 0x21 (ITU-T Recommendation H.264 | ISO/IEC 14496-10). For the AVC parameter set elementary stream, the objectTypeIndication value shall equal 0x22 (Parameter Sets from ITU-T Recommendation H.264 | ISO/IEC 14496-10).

14.3 Stream dependency

If the parameter set elementary stream is present, the elementary stream descriptors for the two streams shall satisfy the following conditions:

- (1) The video elementary stream is dependent on the parameter set elementary stream and the ES_Descriptor for the video elementary stream shall have a streamDependenceFlag equal to true and indicate the ESID of the parameter set elementary stream in the dependsOnESID field. The streamDependenceFlag in the ES_Descriptor for the parameter set elementary stream shall be false.
- (2) The elementary stream clocks for the parameter set elementary stream and the video elementary stream shall be the same and synchronized. The OCRstreamflag and OCR_ES_Id fields in the ESDescriptor for the video elementary stream and parameter set elementary streams shall be used to indicate that both streams share the same OCR.

14.4 Usage of ISO/IEC 14496-14 AVC File Format in MPEG-4 Systems

This subclause specifies how the AVC file format shall be used when the file is marked as being compatible with the MPEG-4 file format specified in ISO/IEC 14496-14. This subclause applies when the file is branded with the MPEG-4 file format brand of 'mp41' or 'mp42', and the AVC video data must be used in an MPEG-4 systems context.

14.4.1 Forming the Elementary Stream Descriptor

As is normal for MPEG-4 streams, the TrackID is related to the ElementaryStreamID, and the SLConfigDescriptor is generated following the rules for any MPEG-4 stream. The format of the ES Descriptor is specified in clause 13 of the MPEG-4 systems specification [ISO/IEC 14496:2001].

If the Elementary Stream Descriptor should contain any other descriptors than SLConfigDescriptor or DecoderConfigDescriptor, they are stored in the Sample Description as defined in ISO/IEC 14496-15 subclause 5.3.4.1.

14.4.2 Forming the DecoderConfigDescriptor

The buffersizeDB, maxBitrate, and avgBitrate fields can be filled by inspection of the VUI Sequence Parameters, if present in the sequence parameter set for the AVC stream.

The DecoderSpecificInfo is formed using the contents of the AVCConfigurationBox.

14.4.3 Elementary Stream Descriptors

The use of multiple non-dependent elementary stream descriptors may also be indicated by the presence of more than one independent AVC video elementary stream descriptors in an object descriptor.

14.4.4 Switching Picture Tracks

Switching picture tracks are not MPEG-4 elementary streams and shall not be included within an MPEG-4 object descriptor.

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*Technologies de l'information — Codage des objets audiovisuels —
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*AMENDEMENT 7: Utilisation du codage vidéo avancé dans les
systèmes MPEG-4*

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^d Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-3 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-3, 6.2.1.

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14.1 SL packet encapsulation of AVC Access Unit

The definition of AVC Access Unit is specified in 7.4.1.2 of ITU-T Recommendation H.264 | ISO/IEC 14496-10. Following restrictions and recommendation are applied when it is encapsulated as an SL packet.

- Start Codes shall not be present in the stream. The field indicating the size of each following NAL unit shall be added before NAL unit. The size of this field is defined in DecoderSpecificInfo.
- SL packet whose randomAccessPointFlag in the header is set to '1' and subsequent SL packets shall carry access units that parameter sets required to decode are provided prior to their use.
- The Picture Timing SEI message that defines the timing information may be present in the video elementary stream, as this message contains other information than timing, and may be required for conformance testing of decoder. However, when it is encapsulated as SL packets, those time information carried by the Picture Timing SEI message shall not be used to decide decoding time or composition time of access unit. Timing information for decoding and composition shall be provided by SL packet header.
- It is recommended encapsulating one NAL unit in one SL packet when it is delivered over lossy environment.

14.2 Handling of Parameter Sets

14.2.1 Usage of DecoderSpecificInfo

Parameter Sets of AVC contents may be updated dynamically. However, DecoderSpecificInfo carrying Parameter Sets shall not be changed through the session. Parameter Sets carried in the DecoderSpecificInfo shall be updated by one of two way as follows:

- Sequence or Picture Parameter Set NAL units may be inserted in the video stream;
- A parameter set elementary stream, containing only parameter set access units, may be used to carry parameter sets separately from AVC video elementary stream. When the parameter set elementary stream is used, access units in AVC video elementary stream shall not carry parameter sets. The parameter sets shall be updated when the decoding time defined in the header of SL packet carrying those parameter sets is reached.

14.2.1.1 Decoder Specific Information

This subclause defines the `DecoderSpecificInfo` descriptor for an AVC elementary stream.

14.2.1.1.1 Syntax

```
aligned(8) class AVCDecoderSpecificInfo extends DecoderSpecificInfo : bit(8)
tag=DecSpecificInfoTag {
    AVCVideoConfigurationRecord config;
}
```

14.2.1.1.2 Semantics

The decoder specific information for an AVC stream contains an AVC video stream decoder configuration record, which is defined in ISO/IEC 14496-15 subclause 5.2.4.

`config` contains the decoder configuration record for the AVC elementary stream decoder configuration.

14.2.1.2 Object type indication

The DecoderConfigDescriptor shall set the value of streamtype equal to 0x04 for both AVC video elementary stream and the AVC parameter set elementary streams.

The DecoderConfigDescriptor for an AVC video elementary stream, possibly including in-line sequence or picture parameter sets, shall set objectTypeIndication to be 0x21 (ITU-T Recommendation H.264 | ISO/IEC 14496-10). For the AVC parameter set elementary stream, the objectTypeIndication value shall equal 0x22 (Parameter Sets from ITU-T Recommendation H.264 | ISO/IEC 14496-10).

14.3 Stream dependency

If the parameter set elementary stream is present, the elementary stream descriptors for the two streams shall satisfy the following conditions:

- (1) The video elementary stream is dependent on the parameter set elementary stream and the ES_Descriptor for the video elementary stream shall have a streamDependenceFlag equal to true and indicate the ESID of the parameter set elementary stream in the dependsOnESID field. The streamDependenceFlag in the ES_Descriptor for the parameter set elementary stream shall be false.
- (2) The elementary stream clocks for the parameter set elementary stream and the video elementary stream shall be the same and synchronized. The OCRstreamflag and OCR_ES_Id fields in the ESDescriptor for the video elementary stream and parameter set elementary streams shall be used to indicate that both streams share the same OCR.

14.4 Usage of ISO/IEC 14496-14 AVC File Format in MPEG-4 Systems

This subclause specifies how the AVC file format shall be used when the file is marked as being compatible with the MPEG-4 file format specified in ISO/IEC 14496-14. This subclause applies when the file is branded with the MPEG-4 file format brand of 'mp41' or 'mp42', and the AVC video data must be used in an MPEG-4 systems context.

14.4.1 Forming the Elementary Stream Descriptor

As is normal for MPEG-4 streams, the TrackID is related to the ElementaryStreamID, and the SLConfigDescriptor is generated following the rules for any MPEG-4 stream. The format of the ES Descriptor is specified in clause 13 of the MPEG-4 systems specification [ISO/IEC 14496:2001].

If the Elementary Stream Descriptor should contain any other descriptors than SLConfigDescriptor or DecoderConfigDescriptor, they are stored in the Sample Description as defined in ISO/IEC 14496-15 subclause 5.3.4.1.

14.4.2 Forming the DecoderConfigDescriptor

The buffersizeDB, maxBitrate, and avgBitrate fields can be filled by inspection of the VUI Sequence Parameters, if present in the sequence parameter set for the AVC stream.

The DecoderSpecificInfo is formed using the contents of the AVCConfigurationBox.

14.4.3 Elementary Stream Descriptors

The use of multiple non-dependent elementary stream descriptors may also be indicated by the presence of more than one independent AVC video elementary stream descriptors in an object descriptor.

14.4.4 Switching Picture Tracks

Switching picture tracks are not MPEG-4 elementary streams and shall not be included within an MPEG-4 object descriptor.

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Information technology – Coding of audio-visual objects –

Part 1: Systems

AMENDMENT 2: Textual format

Technologies de l'information – Codage des objets audiovisuels –

Partie 1: Systèmes

AMENDEMENT 2: Format textuel

Please see the administrative notes on page iii

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Amendment 2 to ISO/IEC 14496-1:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Information technology – Coding of audio-visual objects

Part 1: Systems

Amendment 2: Textual format

In subclause 0.2, replace the following sentences:

" Elementary streams contain the coded representation of either audio or visual data or scene description information. Elementary streams may as well themselves convey information to identify streams, to describe logical dependencies between streams, or to describe information related to the content of the streams. Each elementary stream contains only one type of data.

with

" Elementary streams contain the coded representation of either audio or visual data or scene description information or user interaction data. Elementary streams may as well themselves convey information to identify streams, to describe logical dependencies between streams, or to describe information related to the content of the streams. Each elementary stream contains only one type of data.

Then, add the following subclause:

0.6.5 Interaction Streams

The coded representations of user interaction information is not in the scope of ISO/IEC 14496. But this information shall be translated into scene modification and the modifications made available to the composition process for potential use during the scene rendering.

In clause 4, add the following definitions:

Interaction Stream

An elementary stream that conveys user interaction information.

Media Node

The following list of time dependent nodes that refers to a media stream through a URL field: AnimationStream, AudioBuffer, AudioClip, AudioSource, Inline, MovieTexture.

Media stream

One or more elementary streams whose ES descriptors are aggregated in one object descriptor and that are jointly decoded to form a representation of an AV object.

Media time line

A time line expressing normal play back time of a media stream.

Seekable

A media stream is seekable if it is possible to play back the stream from any position.

Stream object

A media stream or a segment thereof. A stream object is referenced through a URL field in the scene in the form "OD:n" or "OD:n#<segmentName>" .

"

In subclause 8.2.3.2, replace table 2:

"

Table 2 - List of Class Tags for Commands

| Tag value | Tag name |
|-----------|---------------------------------|
| 0x00 | forbidden |
| 0x01 | ObjectDescrUpdateTag |
| 0x02 | ObjectDescrRemoveTag |
| 0x03 | ES_DescrUpdateTag |
| 0x04 | ES_DescrRemoveTag |
| 0x05 | IPMP_DescrUpdateTag |
| 0x06 | IPMP_DescrRemoveTag |
| 0x07 | ES_DescrRemoveRefTag |
| 0x08-0xBF | Reserved for ISO (command tags) |
| 0xC0-0xFE | User private |
| 0xFF | forbidden |

"

with

"

Table 2 - List of Class Tags for Commands

| Tag value | Tag name |
|-----------|---------------------------------|
| 0x00 | forbidden |
| 0x01 | ObjectDescrUpdateTag |
| 0x02 | ObjectDescrRemoveTag |
| 0x03 | ES_DescrUpdateTag |
| 0x04 | ES_DescrRemoveTag |
| 0x05 | IPMP_DescrUpdateTag |
| 0x06 | IPMP_DescrRemoveTag |
| 0x07 | ES_DescrRemoveRefTag |
| 0x08 | ObjectDescrExecuteTag |
| 0x09-0xBF | Reserved for ISO (command tags) |
| 0xC0-0xFE | User private |
| 0xFF | forbidden |

"

After 8.5.5.7.2 (ODEExecute), add the following subclause:

"

8.5.5.8 ObjectDescriptorExecute

8.5.5.8.1 Syntax

```
class ObjectDescriptorExecute extends BaseCommand : bit(8) tag= ObjectDescriptorExecuteTag {
    bit(10) objectDescriptorId[(sizeOfInstance*8)/10];
}
```

8.5.5.8.2 Semantics

The ObjectDescriptorExecute class instructs the terminal that Elementary streams contained therein shall be opened as the server will transmit data on one or more of the streams. Failure by the terminal to comply may result in data loss and/or other undefined behavior.

"

In subclause 8.6.4.2 (Semantics), replace Tables 4 and 7 with:

Table 4 - sceneProfileLevelIndication Values

| Value | Profile | Level |
|--------------|------------------------------------|--------------|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Simple 2D profile | L1 |
| 0x02 | Simple 2D profile | L2 |
| 0x03 | Basic 2D profile | L1 |
| 0x04 | Core 2D profile | L1 |
| 0x05 | Core 2D profile | L2 |
| 0x06 | Main 2D profile | L1 |
| 0x07 | Main2D profile | L2 |
| 0x08 | Main 2D profile | L3 |
| 0x09 | Advanced 2D profile | L1 |
| 0x0A | Advanced 2D profile | L2 |
| 0x0B | Advanced 2D profile | L3 |
| 0x0C-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no scene graph profile specified | - |
| 0xFF | no scene graph capability required | - |

NOTE — Usage of the value 0xFE indicates that the content described by this InitialObjectDescriptor does not comply to any scene graph profile specified in ISO/IEC 14496-1. Usage of the value 0xFF indicates that none of the scene graph profile capabilities are required for this content.

Table 7 - graphicsProfileLevelIndication Values

| Value | Profile | Level |
|--------------|---------------------------------|--------------|
| 0x00 | Reserved for ISO use | |
| 0x01 | Simple 2D profile | L1 |
| 0x02 | Simple 2D + Text profile | L1 |
| 0x03 | Simple 2D + Text profile | L2 |
| 0x04 | Core 2D profile | L1 |
| 0x05 | Core 2D profile | L2 |
| 0x06 | Advanced 2D profile | L1 |
| 0x07 | Advanced 2D profile | L2 |
| 0x08-0x7F | reserved for ISO use | |
| 0x80-0xFD | user private | |
| 0xFE | no graphics profile specified | |
| 0xFF | no graphics capability required | |

NOTE — Usage of the value 0xFE may indicate that the content described by this InitialObjectDescriptor does not comply to any conformance point specified in ISO/IEC 14496-1. Usage of the value 0xFF indicates that none of the graphics profile capabilities are required for this content.

In subclause 8.6.6.2, replace Table 8 with:

Table 8 - objectTypeIndication Values

| Value | ObjectTypeIndication Description |
|--------------|---|
| 0x03 | Interaction Stream |
| 0x04-0x1F | reserved for ISO use |

In subclause 8.6.6.2, replace Table 9 with:

Table 9 - streamType Values

| streamType value | stream type description |
|-------------------------|--------------------------------|
| 0x0A | Interaction Stream |
| 0xB - 0x1F | reserved for ISO use |

"

In subclause 8.6.7.2 Semantics (of DecoderSpecificInfo), add the following paragraph:

"

For values of DecoderConfigDescriptor.objectTypeIndication that refer to interaction streams, the decoder specific information is:

```
class UIConfig extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {
    bit(8) deviceNameLength;
    bit(8) deviceName[deviceNameLength];
    bit(8) devSpecInfo[sizeOfInstance - deviceNameLength - 1];
}
```

with

deviceNameLength – indicates the number of bytes in the deviceName field

deviceName – indicates the name of the class of device, which allows the terminal to invoke the appropriate interaction decoder.

devSpecInfo – is a opaque container with information for a device specific handler.

"

After subclause 8.6.18.13.3 (SegmentDescriptor, MediaTimeDescriptor), add the following new subclauses:

"

8.6.18.14 Segment Descriptor

8.6.18.14.1 Syntax

```
class SegmentDescriptor extends OCI_Descriptor : bit(8) tag=SegmentDescriptorTag {
    double start;
    double duration;
    bit(8) segmentNameLength;
    bit(8) segmentName [segmentNameLength];
};
```

8.6.18.14.2 Semantics

The segment descriptor defines labeled segments within a media stream with respect to the media time line. A segment for a given media stream is declared by conveying a segment descriptor with appropriate values as part of the object descriptor that declares that media stream. Conversely, when a segment descriptor exists in an object descriptor, it refers to all the media streams in that object descriptor. Segments can be referenced from the scene description through **url** fields of media nodes.

In order to use segment descriptors for the declaration of segments within a media stream, the notion of a media time line needs to be established. The media time line of a media stream may be defined through use of media time descriptor (see 8.6.18.15). In the absence of such explicit definitions, media time of the first composition unit of a media stream is assumed to be zero. In applications where random access into a media stream is supported, the media time line is undefined unless the media time descriptor mechanism is used.

start – specifies the media time (in seconds) of the start of the segment within the media stream.

duration – specifies the duration of the segment in seconds. A negative value denotes an infinite duration.

SegmentNameLength – the length of the segmentName field in characters.

`segmentName` – a Unicode [3] encoded string that labels the segment. The first character of the `segmentName` shall be an alphabetic character. The other characters may be alphanumeric, `_`, `-`, or a space character.

8.6.18.15 MediaTimeDescriptor

8.6.18.15.1 Syntax

```
class MediaTimeDescriptor extends OCI_Descriptor : bit(8) tag=MediaTimeDescrTag {
    double mediaTimeStamp;
};
```

8.6.18.15.2 Semantics

The media time descriptor conveys a media time stamp. The descriptor establishes the mapping between the object time base and the media time line of a media stream. This descriptor shall only be conveyed within an OCI stream. The `startingTime`, `absoluteTimeFlag` and `duration` fields of the OCI event carrying this descriptor shall be set to 0. The association between the OCI stream and the corresponding media stream is defined by an object descriptor that aggregates ES descriptors for both of them (see 8.7.1.3).

`mediaTimeStamp` – a time stamp indicating the media time (MT, in seconds) of the associated media stream corresponding to the composition time (CT) of the access unit conveying the media time descriptor. Media time values $MT(AU_n)$ of other access units of the media stream can be calculated from the composition time $CT(AU_n)$ for that access unit as follows:

$$MT(AU_n) = CT(AU_n) - CT + MT$$

with `MT` and `CT` being the `mediaTimeStamp` and `compositionTimeStamp` (converted to seconds) values, respectively, for the access unit conveying the media time descriptor.

Note – When media time descriptor is used to associate a media time line with a media stream, the notion of “media time zero” does not necessarily correspond to the notion of “beginning of the stream.”

“

Replace subclause 9.2.1.6 with:

“

9.2.1.6 Time

9.2.1.6.1 Stream Objects

A Media Stream consists of one or more elementary streams whose ES descriptors are aggregated in one object descriptor and that are jointly decoded to form a representation of an AV object. Such streams may be streamed in response to player requests, in particular in the case of Media nodes that control play back of media. Streams may be seekable, in which case the stream can be played from any (randomly accessible) time position in the stream, or they may be non-seekable, in which case the player has no control over the playback of the stream, as is the case in broadcast scenarios.

9.2.1.6.2 Time-dependent Media Nodes

This specification defines the notion of a Media Node. Such nodes control the opening and playback of remote streams and are time-dependent nodes.

The `url` field of a media node shall contain at most one element which must point to a complete media stream, i.e. it is of the form “OD:n”. Media Nodes may become active or inactive based on the value of their `startTime` and `stopTime` fields. The mediaTime of the played stream is controlled by a MediaControl node, and is not dependent on the `startTime` and `stopTime` in the media Node.

The semantics of the `loop`, `startTime` and `stopTime` exposedFields and the `isActive` eventOut in time-dependent nodes are as described in ISO/IEC 14772-1:1998, subclause 4.6.9 [10]. `startTime`, `stopTime` and `loop` apply only to the local start, pause and restart of these nodes. In the case of media Nodes, these fields affect the delivery of the stream attached to media nodes as described below. The following media nodes exist: AnimationStream, AudioBuffer, AudioClip, AudioSource, MovieTexture, TimeSensor.

When a media node becomes active and the stream associate with that media node is already active, the media node simply joins the session. If the stream is not active when the media node becomes active, the stream becomes active; i.e. it is played.

When a media node becomes inactive, the stream shall become inactive if there are no other active media nodes referring to that stream, otherwise the stream remains active.

Loop and **speed** in a MediaControl node shall over-ride the same fields, when they exist, in any media node referencing the controlled stream. These fields retain their semantics when no controlling MediaControl node is present in the scene.

9.2.1.6.3 Time fields in BIFS nodes

Several BIFS nodes have fields of type SFTime that identify a point in time at which an event occurs (change of a parameter value, start of a media stream, etc). Depending on the individual field semantics, these fields may contain time values that refer either to an absolute position on the time line of the BIFS stream or that define a time duration.

As defined in 9.2.1.4, the speed of the flow of time for events in a BIFS stream is determined by the time base of the BIFS stream. This determines unambiguously durations expressed by relative SFTime values like the **cycleTime** field of the TimeSensor node. The time base of a stream can be modified by the TemporalTransform node which is used to synchronize different streams.

The semantics of some SFTime fields is such that the time values shall represent an absolute position on the time line of the BIFS stream (e.g. **startTime** in MovieTexture). This absolute position is defined as follows:

Each node in the scene description has an associated point in time at which it is inserted in the scene graph or at which an SFTime field in such a node is updated through a **CommandFrame** in a BIFS access unit (see 9.2.1.3). The value in the SFTime field as coded in the delivered BIFS command is the positive offset from this point in time in seconds. The absolute position on the time line shall therefore be calculated as the sum of the composition time of the BIFS access unit and the value of the SFTime field.

NOTE 1 — Absolute time in ISO/IEC 14772-1:1998 is defined slightly differently. Due to the non-streamed nature of the scene description in that case, absolute time corresponds to wallclock time in [10].

EXAMPLE — The example in Figure shows a BIFS access unit that is to become valid at CTS. It conveys a node that has an associated media elementary stream. The startTime of this node is set to a positive value Δt . Hence, startTime will occur Δt seconds after the CTS of the BIFS access unit that has incorporated this node (or the value of the startTime field) in the scene graph.

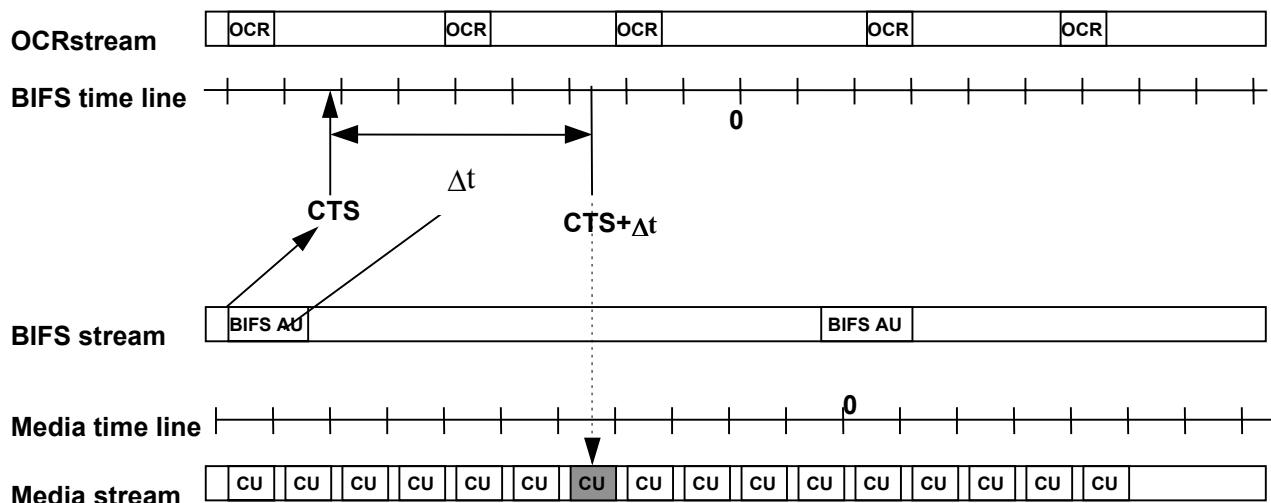


Figure 12 - Media start times and CTS

The following sentence should be added to subclause 9.2.2.7.1:

In the case of **InputSensor**, the node includes a reference to an object descriptor that indicates which user interaction stream is associated with the node.

Add a new subclause after subclause 9.2.2.7.2 (URL : segment syntax):

9.2.2.7.3 Object descriptor references in URL fields

The **url** fields in several nodes contain references to media streams. Depending on the profile and level settings (see clause 15), references to media streams are made through object descriptor IDs. The textual syntax for the **url** fields in this case is as follows:

“od:<number>” - refers to the object descriptor with the id <number>.

“od:<number>#<segmentName>” - refers to the stream object defined within the object descriptor with the id <number> that has the name <segmentName>.

“od:<number>#<segmentName1>:<segmentName2>” - refers to all stream objects defined within the object descriptor with the id <number> that start at the same time or later as <segmentName1> and that end at the same time or earlier than <segmentName2>

“od:<number>#<segmentName1>+” - refers to all stream objects defined within the object descriptor with the id <number> that start at the same time or later as <segmentName1> until the end of the media stream.

“

Replace subclause 9.3.7.20.2 (SFUrl Semantics) with:

9.3.7.20.2 Semantics

The “od:” URL scheme is used in an **url** field of a BIFS node to refer to an object descriptor. The integer immediately following the “od:” prefix identifies the **ObjectDescriptorID**. For example, “od:12” refers to object descriptor number 12.

If the **SFUrl** refers to an object descriptor, the **ObjectDescriptorID** is coded as a 10-bit integer. If the **SFUrl** refers to a segment of a media stream (“od:12#<segmentName>”) and in all other cases the URL is sent as an **SFString**.

“

In subclause 9.4.2, insert the following subclause between the specifications of the **Inline** node and the **Layer2D** node:

9.4.2.63 InputSensor

9.4.2.63.1 Node interface

| | | | | |
|----------------------|--------------|----------|------------------|------|
| InputSensor { | exposedField | SFBool | enabled | TRUE |
| | exposedField | SFString | buffer | ”” |
| | exposedField | SFString | url | ”” |
| | eventOut | SFTime | eventTime | |
| } | | | | |

NOTE — For the binary encoding of this node see Annex [H.3.11](#).

9.4.2.63.2 Functionality and semantics

The **InputSensor** node is used to add entry points for user inputs into a BIFS scene. It allows user events to trigger updates of the value of a field or the value of an element of a multiple field of an existing node.

Input devices are modelled as devices that generate frames of user input data. A device data frame (DDF) consists in a *list of values of any of the allowed types for node fields*. Values from DDFs are used to update the scene. For example, the DDF definition for a simple mouse is:

```
MouseDataFrame [[
    SFVec2f      cursorPosition
    SFFloat     singleButtonDown
]]
```

Note: The encoding of the DDF is implementation-dependent. Devices may send only complete DDF or sometimes subsets of DDF as well.

The **buffer** field is a buffered bit string which contains a list of BIFS-Commands in the form of a `CommandFrame` (see 9.3.6.2). Allowed BIFS-Commands are the following: `FieldReplacement` (see 9.3.6.14), `IndexedValueReplacement` (see 9.3.6.15) and `NodeDeletion` with a NULL node argument (see 9.3.7.3.2). The **buffer** shall contain a number of BIFS-Commands that matches the number of fields in the DDF definition for the attached device. The type of the field replaced by the n^{th} command in the **buffer** shall match the type of the n^{th} field in the DDF definition.

The **url** field specifies the data source to be used (see 9.2.2.7.1). The **url** field shall point to a stream of type `UserInteractionStream`, which "access units" are DDFs.

When the **enabled** is set to TRUE, upon reception of a DDF, each value (in the order of the DDF definition) is placed in the corresponding replace command according to the DDF definition, then the replace command is executed. These updates are not time-stamped; they are executed at the time of the event, assuming a zero-decoding time. It is not required that all the replace commands be executed when the **buffer** is executed. Each replace command in the **buffer** can be independently triggered depending on the data present in the current DDF. Moreover, the presence in the **buffer** field of a `NodeDeletion` command at the n^{th} position indicates that the value of the DDF corresponding to the n^{th} field of the DDF definition shall be ignored.

The **eventTime** eventOut carrying the current time is generated after a DDF has been processed.

EXAMPLE — A typical use of this node is to handle the inputs of a keyboard.

9.4.2.63.3 Adding New Devices and Interoperability

In order to achieve interoperability when defining new devices, the way to use `InputSensor` with the new device needs to be specified. The following steps are necessary:

- define the content of the DDF definition: this sets the order and type of the data coming from the device and then mandates the content of the `InputSensor` buffer.
- define the `deviceName` string which will designate the new device.
- define the optional `devSpecInfo` of `UIConfig`.

Note: the bitstream syntax does not need to change.

9.4.2.63.4 Keyboard Mappings

The **KeySensor mapping** is defined as follows.

The KeySensor DDF definition is:

```
KeySensorDataFrame [[
    SFInt32 keyPressed
    SFInt32 keyReleased
    SFInt32 actionKeyPressed
    SFInt32 actionKeyReleased
    SFBool shiftKeyChanged
    SFBool controlKeyChanged
    SFBool altKeyChanged
]]
```

`keyPress` and `keyRelease` events are generated as keys which produce characters are pressed and released on the keyboard. The value of these events is a string of length 1 containing the single UTF-8 character associated with the key pressed. The set of UTF-8 characters that can be generated will vary between different keyboards and different implementations.

`actionKeyPress` and `actionKeyRelease` events are generated as 'action' keys are pressed and released on the keyboard. The value of these events are:

| KEY | VALUE | KEY | VALUE | KEY | VALUE |
|------|-------|-------|-------|--------|-------|
| HOME | 13 | END | 14 | PGUP | 15 |
| PGDN | 16 | UP | 17 | DOWN | 18 |
| LEFT | 19 | RIGHT | 20 | F1-F12 | 1-12 |

shiftKeyChanged, controlKeyChanged, and altKeyChanged events are generated as the shift, alt and control keys on the keyboard are pressed and released. Their value is TRUE when the key is pressed and FALSE when the key is released.

The KeySensor UIConfig.devSpecInfo is empty.

The KeySensor deviceName is "KeySensor"

The **StringSensor mapping** is defined as follows.

The StringSensor DDF definition is:

```
StringSensorDataFrame [ [
    SFString enteredText
    SFString finalText
]]
```

The StringSensor UIConfig.devSpecInfo contains 2 UTF-8 strings: the first one is called terminationCharacter and the second one is called deletionCharacter. When no devSpecInfo is provided, the default terminationCharacter is '\r' and the default deletionCharacter is '\b'.

enteredText events are generated as keys which produce characters are pressed on the keyboard. The value of this event is the UTF-8 string entered including the latest character struck. The set of UTF-8 characters that can be generated will vary between different keyboards and different implementations. If deletionCharacter is provided, the previously entered character in the enteredText is removed. The deletionCharacter field contains a string comprised of one UTF-8 character. It may be a control character. If the deletionCharacter is the empty string, no deletion operation is provided.

The finalText event is generated whenever a sequence of keystrokes are recognized which match the keys in the terminationText string. When this recognition occurs, the enteredText is moved to the finalText and the enteredText is set to the empty string. This causes both a finalText event and an enteredText event to be generated.

The StringSensor deviceName is "StringSensor"

9.4.2.63.5 Mouse Mappings

The Mouse mapping is defined as follows.

The Mouse DDF definition is:

```
MouseDataFrame [ [
    SFVec2f position
    SFBool leftButtonDown
    SFBool middleButtonDown
    SFBool rightButtonDown
    SFFloat wheel
]]
```

position is specified in screen coordinates, pixels or meter as specified in the BifsConfig. leftButtonDown becomes true when the left button is down, and false otherwise. Likewise for the middle and right buttons respectively. wheel values are: 0 when the wheel is inactive, +1 (resp. -1) when the wheel is moved forward (resp. backward) by one delta.

The Mouse UIConfig.devSpecInfo is empty.

The Mouse deviceName is "Mouse".

Note: This mouse mapping can be used with mice with 1 button, 2 buttons or 3 buttons, and possibly a wheel. DDF fields for missing buttons or wheel are simply never activated.

After 9.4.2.71 (*MatteTexture*, *MediaBuffer*, *MediaControl*, *MediaSensor*), add the following subclauses:

9.4.2.72 *MatteTexture*

9.4.2.72.1 Node interface

MatteTexture {

| | | | |
|--------------|----------|---------------------|-------|
| field | SFNode | surfaceA | NULL |
| field | SFNode | surfaceB | NULL |
| field | SFNode | alphaSurface | NULL |
| exposedField | SFString | operation | “” |
| field | SFBool | overwrite | FALSE |
| exposedField | SFFloat | fraction | 0 |
| exposedField | MFFloat | parameter | 0 |

}

NOTE — For the binary encoding of this node see Annex H.6.2.

9.4.2.72.2 Functionality and semantics

The *MatteTexture* node uses image compositing operations to combine the image data from two surfaces onto a third surface. The result of the compositing operation is computed at the resolution of **surfaceB**. If the size of **surfaceA** differs from that of **surfaceB**, the image data on **surfaceA** is zoomed up or down before performing the operation.

The compositing operations that are defined are capable of being hardware accelerated using low-cost, widely available graphics accelerators.

The **surfaceA**, **surfaceB** and **alphaSurface** fields specify the three surfaces that provide the input image data for the compositing operation. Not all three surfaces have to be specified. In particular, there are unary, binary, and ternary operations. Each of these fields can contain any MPEG-4 texture node. These include *CompositeTexture2D*, *CompositeTexture3D*, *PixelTexture*, *MovieTexture*, *ImageTexture* and *MatteTexture*.

The **operation** field specifies what compositing function to perform on the input surfaces.

The **parameter** and **fraction** fields provide one or more floating point parameters that can alter the effect of the compositing function. The specific interpretation of the parameter values depends upon which operation is specified.

The **overwrite** field indicates whether the *MatteTexture* node should allocate a new surface for storing the result of the compositing operation (**overwrite** = FALSE) or whether the data stored on **surfaceB** should be overwritten with the results of the compositing operation (**overwrite** = TRUE).

Note: Authors should only set **overwrite** to TRUE when they are certain that overwriting the contents of **surfaceB** will not have any adverse side-effects.

The possible values for **operation** are:

Unary Operations operate on the texture in the surfaceB field: “INVERT” replaces the value C in each channel of with 1-C. The **parameter** field is used to specify whether or not channels containing alpha are inverted. If **parameter** is 0, then alpha channels are not inverted. If **parameter** is 1, then alpha channels are inverted.

“OFFSET” shifts the image DX pixels to the right and DY pixels to the top. Negative DX and DY values shift the image left and down, respectively. The DX and DY value are taken as the first two values in the parameter field. The color of pixels that are exposed by the OFFSET operation is set to black with an alpha value of 1.

“SCALE” scales each channel independently by multiplying the color in channel i by the value in **parameter[i]**. Pixel color and alpha values are clamped to the range 0 to 1. “BIAS” modifies the color in channel i by adding to it the value in **parameter[i]**. Pixel color and alpha values are clamped to the range 0 to 1.

"BLUR" performs a Gaussian blur operation on the image. The Gaussian blur kernel is an approximation of the normalized convolution:

$$H(x) = \exp(-x^2 / (2s^2)) / \sqrt{2\pi s^2}$$

Where 's' is the standard deviation.

The value of [stdDeviation](#) is specified in the **parameter** field and can be either one or two numbers. If two numbers are provided, the first number represents a standard deviation value along the x-axis of the surface and the second value represents a standard deviation along the y-axis. If one number is provided, then that value is used for both x and y. Even if only one value is provided for [stdDeviation](#), this can be implemented as a separable convolution.

Note: For larger values of 's' ($s \geq 2.0$), an approximation may be used: Three successive box-blurs build a piecewise quadratic convolution kernel, which approximates the Gaussian kernel to within roughly 3%.

let $d = \text{floor}(s * 3 * \sqrt{2\pi}) / 4 + 0.5$

... if d is odd, use three box-blurs of size ' d ', centered on the output pixel.

... if d is even, two box-blurs of size ' d ' (the first one centered one pixel to the left, the second one centered one pixel to the right of the output pixel) and one box blur of size ' $d+1$ ' centered on the output pixel.

"COLOR_MATRIX" multiplies the RGBA value of each pixel by a matrix:

$$\begin{vmatrix} R' \\ G' \\ B' \\ A' \end{vmatrix} = \begin{vmatrix} a_{00} & a_{01} & a_{02} & a_{03} \\ a_{10} & a_{11} & a_{12} & a_{13} \\ a_{20} & a_{21} & a_{22} & a_{23} \\ a_{30} & a_{31} & a_{32} & a_{33} \end{vmatrix} * \begin{vmatrix} R \\ G \\ B \\ A \end{vmatrix}$$

This matrix can be used for many purposes, including swapping channels and performing color space conversions. The matrix values are given in row order in the **parameter** field.

As an example, the following matrix swaps the red and blue channels:

$$\begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

The following matrix converts luminance to alpha:

$$\begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0.299 & 0.587 & 0.114 & 0 \end{vmatrix}$$

Binary Operations operate on the textures in the **surfaceB** and either the **surfaceA** or **alphaSurface** fields:

"REPLACE_ALPHA" combines the RGB channels of **surfaceB** with the alpha channel from **alphaSurface**. If **alphaSurface** has 1 component (grayscale intensity only), that component is used as the alpha values. If **alphaSurface** has 2 or 4 components (grayscale intensity+alpha or RGBA), the alpha channel is used to provide the alpha values. If **alphaSurface** has 3 components (RGB), the operation is undefined. This operation can be used to provide static or dynamic alpha masks for static or dynamic imagery. For example, a texture node could render an animating James Bond character against a transparent background. The alpha from this image could then be used as a mask shape for a video clip.

"MULTIPLY_ALPHA" behaves just like REPLACE_ALPHA, except the alpha values from **alphaSurface** are multiplied with the alpha values from **surfaceB**.

"CROSS_FADE" fades between two surfaces using the value in the fraction field to control the percentage of each surface that is visible. This operation can dynamically fade between two static or dynamic images. By animating the fraction field value from 0 to 1, the imagery on **surfaceA** fades into that of **surfaceB**.

"BLEND" combines the image data from **surfaceA** and **surfaceB** using the alpha channel from **surfaceB** to control the blending percentage. This operation allows the alpha channel of **surfaceB** to control the blending of the two images. By animating the alpha channel of **surfaceB** by rendering a texture node or playing a MovieTexture, you can produce a complex traveling matte effect. If R1, G1, B1, and A1 represent the red, green, blue, and alpha values of a pixel of **surfaceA** and R2, G2, B2, and A2 represent the red, green, blue, and alpha values of the corresponding pixel of **surfaceB**, then the resulting values of the red, green, blue, and alpha components of that pixel are:

$$\text{red} = R1 * (1 - A2) + R2 * A2$$

$$\text{green} = G1 * (1 - A2) + G2 * A2$$

$$\text{blue} = B1 * (1 - A2) + B2 * A2$$

$$\text{alpha} = 1$$

"ADD", and "SUBTRACT" add or subtract the color channels of **surfaceA** and **surfaceB**. The alpha of the result equals the alpha of **surfaceB**.

"A" is the identity operator for **surfaceA**. In other words, the resulting image contains the contents of **surfaceA**. If overwrite is TRUE, then the contents of **surfaceB** are overwritten with the contents of **surfaceA**.

"B" is the identity operator for **surfaceB**. In other words, the resulting image contains the contents of **surfaceB**.

Ternary Operations operate on the textures in the **surfaceA**, **surfaceB**, and **alphaSurface** fields:

"REVEAL" is similar to CROSS_FADE except that the **fraction** value does not directly specify the percentage of **surface1** and **surface2** to use in the result. Instead, the **fraction** value specifies a threshold level for a third surface (i.e. the **alphaSurface**). In regions of the **alphaSurface** where the alpha values are less than the threshold, the resulting pixels come from **surface1**. In regions of the **alphaSurface** where the alpha values are greater than the threshold, the resulting pixels come from **surface2**.

So far, this describes a hard-edged transition region between **surface1** and **surface2**. In other words, each pixel of the result comes directly from either **surface1** or **surface2**. Introducing a softness value (which is specified using the first value of the **parameter** field), allows a range of alpha values surrounding the threshold value to be specified where the result is a linear blend of **surface1** and **surface2**.

For example, if softness (soft) = 0.1, and threshold (thresh) = 0.5, then for alpha values less than or equal to (thresh - soft) = 0.4, the result would be **surface1**. For alpha values greater than or equal to (thresh + soft) = 0.6, then result would be **surface2**. For alpha values between 0.4 and 0.6, then result would be a linear combination of **surface1** and **surface2**:

$$1 - (1/(2*\text{soft})) * (\text{alpha} + \text{soft} - \text{thresh}) * \text{surface1} + (1/(2*\text{soft})) * (\text{alpha} + \text{soft} - \text{thresh}) * \text{surface2}$$

Example :

The following example shows how the node can be used to mix three surfaces.

The following scene uses a "REVEAL" operation to mix two images using an alphaSurface. The figures below show the alphaSurface used (Figure 1) and a snap shot of the operation for a value of TransitionEffect.fraction between 0 and 1 (Figure 2).

```
# content fragment showing an image processing transition effect using
# MatteSurface and its REVEAL operator
#
# MovieA transitions to reveal MovieB on the same in-scene texture,
# as TransitionEffect.fraction is animated from 0.0 to 1.0

DEF VideoScreen Transform {
    children    Shape {
        appearanceAppearance {
```

```

texture DEF TransitionEffect MatteTexture {
    surfaceA DEF MovieA MovieSurface {
        url "A.roll.mpg"
    }
    surfaceB DEF MovieB MovieSurface {
        url "B.roll.mpg"
    }
    alphaSurface ImageSurface {
        url "revealDiamondArt.png"
    }
    parameter 0.063
    operation "REVEAL"
}
}

geometry IndexedFaceSet {
    coord Coordinate {
        point [ -10 -7.5 0,
                -10 7.5 0,
                10 7.5 0,
                10 -7.5 0 ]
    }
    coordIndex [ 0, 1, 2, 3, -1 ]
    solid FALSE
}
}
}
}

```

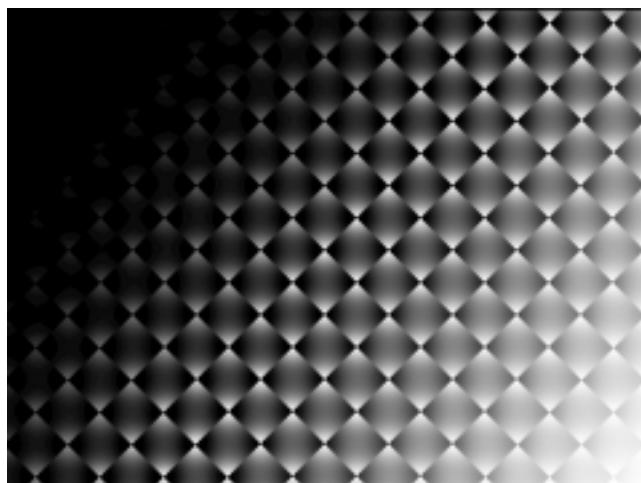


Figure 1 - An alphaSurface (revealDiamondArt.png) used in a “REVEAL” operation to mix two videos.



Figure 2 - An image resulting from a “REVEAL” **operation** on A.roll.mpg and B.roll.mpg using the alphaSurface in Figure 1.

9.4.2.73 MediaBuffer

9.4.2.73.1 Node interface

```
MediaBuffer {
    exposedField SFFloat      bufferSize          0.0
    exposedField MFString       url                []
    exposedField SFTime        mediaStartTime     -1
    exposedField SFTime        mediaStopTime      +1
    eventOut      SFBool        isBuffered
    exposedField SFBool        enabled            TRUE
}
```

NOTE — For the binary encoding of this node see Annex H.6.3.

9.4.2.73.2 Functionality and semantics

The MediaBuffer node allows storage of media streams in local buffers created specifically for playback. This allows, for instance, storage of clips for interactive playback or looping.

Storage of a stream object in the MediaBuffer shall occur only if the stream is active (see MediaControl section).

The time interval of the stream object with media time between **mediaStartTime** and **mediaStopTime** shall be stored. If these values are changed as a stream object is being buffered, the result is undefined.

The **mediaStartTime** or **mediaStopTime** fields have special values; see the MediaControl section.

The **url** field refers to the stream objects that are to be stored; there shall be one buffer for each stream object.

The **bufferSize** field signals how many seconds of media shall be stored locally. If **bufferSize** = -1.0 the whole range of **mediaStartTime** to **mediaStopTime** shall be stored. If this range is unbounded because the duration of the stream object is not known, no buffering shall occur.

Note – The physical buffer sizes can be computed from stream parameters and either the **bufferSize** value or **mediaStartTime** and **mediaStopTime**.

The **isBuffered** event sends a TRUE value when all of the streams in the **url** have been completely buffered.

When the **enabled** field is set to TRUE, the buffers shall be allocated. When the **enabled** field is set to FALSE the buffers may be freed and no buffering shall take place. If a media buffer has insufficient space to add more media samples, the earliest added media samples are discarded and replaced with the most recently received media samples.

When buffering of a stream object is started, all previous buffer contents shall be discarded.

Playback of a stream object shall occur through the MediaBuffer under the following conditions:

- A media node referring to the same stream object referenced in the **url** field of the MediaBuffer becomes active, and
- the requested playback time interval of that stream object is completely available in the MediaBuffer.

Note – Play back of buffered stream object may be controlled by a MediaControl node.

9.4.2.74 MediaControl

9.4.2.74.1 Node interface

MediaControl {

| | | | |
|--------------|----------|-----------------------|-------|
| exposedField | MFString | url | “” |
| exposedField | SFTime | mediaStartTime | -1 |
| exposedField | SFTime | mediaStopTime | +I |
| exposedField | SFFloat | mediaSpeed | 1.0 |
| exposedField | SFBool | loop | FALSE |
| exposedField | SFBool | preRoll | TRUE |
| exposedField | SFBool | mute | FALSE |
| exposedField | SFBool | enabled | TRUE |
| eventOut | SFBool | isPreRolled | |

}

NOTE — For the binary encoding of this node see Annex H.6.4.

9.4.2.74.2 Functionality and semantics

The MediaControl node controls the play back and, hence, delivery of a media stream referenced by a media node. The MediaControl node allows selection of a time interval within one or more stream objects for play back, modification of the playback direction and speed, as well as pre-rolling and muting of the stream.

A media node may be used with or without an associated MediaControl node. A media node for which no MediaControl node is present shall behave as if a MediaControl node for that media stream were present in the scene, with default values set.

The **url** field contains a reference to one or more stream objects (“OD:n#segment” or “OD:n”), called the controlled stream objects, all of which must belong to the same media stream. This media stream is called the controlled stream. When any media node referring to a media stream in its **url** field is active, the associated media stream is said to be active.

Note – This means that the controlled stream becomes active exactly when some media node pointing to it becomes active. The controlled stream becomes inactive, when all media nodes referring to it become inactive.

When a controlled media stream becomes active, the associated controlled stream objects in the **url** field of the MediaControl node shall be played sequentially.

The **mediaStartTime** and **mediaStopTime** fields define the time interval, in media time, of each controlled stream object to be played back.

If media time of the media stream is undefined, selection of a time interval of the controlled stream object for play back is not supported. In that case the **mediaStartTime** and **mediaStopTime** fields shall be ignored.

The following values have special meaning for **mediaStartTime** and **mediaStopTime**:

- 0 indicates the beginning of the controlled stream object
- -1 indicates the media time of the controlled stream object when the associated media node becomes active.
- +I, or any value greater than the duration of the controlled stream object indicates its end.

Semantics of **mediaStartTime** and **mediaStopTime** depend on the delivery scenario.

Semantics in case of delivery scenarios that permit seeking:

Play back of the controlled stream object shall start at **mediaStartTime** of the first controlled media object when the controlled stream becomes active.

When the controlled stream becomes inactive and then active again, then if **mediaStartTime** is –1 the stream starts playing from the point where it was last stopped. Otherwise the first controlled stream object in the **url** field restarts playing from **mediaStartTime**.

If the **loop** field is TRUE, all the controlled stream objects are played in a loop, each in the range **mediaStartTime** to **mediaStopTime** while the controlled stream is active. If **mediaStartTime** is –1, each stream object will start from the beginning.

In all delivery scenarios, play back of the controlled stream object shall occur only in the range defined by **mediaStartTime** and **mediaStopTime**. Outside this range the play back shall be muted. The **loop** field shall be ignored in delivery scenarios that do not permit seeking.

The **mediaSpeed** is a requested multiplication factor to the normal speed of each controlled stream object. Negative values for **mediaSpeed** request that the controlled stream object plays backward from **mediaStartTime** to **mediaStopTime**. When this field is zero, the controlled stream shall be paused.

Note: All streams, independent of speed, are only played in the range defined by **mediaStartTime** and **mediaStopTime**. When **mediaSpeed** < 0, the stream object can only be played if the server reassigns time stamps to be increasing from **mediaStopTime** to **mediaStartTime**.

If **mediaSpeed** > 0 (forward play back) and **mediaStopTime** < **mediaStartTime**, then the controlled stream object will play until the end.

If **mediaSpeed** < 0 (backward play back) and **mediaStopTime** > **mediaStartTime**, then the controlled stream object will play to the beginning.

In these equations, the special value –1 is substituted by the actual value of media time that it represents.

There is no requirement that a delivery service supports specific ranges of **mediaSpeed** other than **mediaSpeed** = 1. Media content shall comply with maximum and average bit rates specified for the stream, irrespective of the value of the **mediaSpeed** field.

If the **preRoll** field is set to TRUE the controlled stream should be pre-rolled in order to be ready to start instantly when the controlled stream becomes active. All streams that are associated to the same object time base as the stream that is pre-rolled should also be pre-rolled.

If the delivery scenario does not permit seeking, **preRoll** = TRUE means that the controlled stream object should be delivered and recently received access units should be stored in the decoding buffer in order to enable instantaneous play back when the media node becomes active.

Note – Play back of stream objects in media nodes that are not controlled by **MediaControl** or where **preRoll** is FALSE may suffer an unspecified startup delay if play back is requested by an unpredictable action (e.g. user interaction, script).

The **isPreRolled** event sends a TRUE value when the controlled stream object has completed pre-rolling.

If the **mute** field is set to TRUE, the stream objects in the **url** field are not rendered when they are played. However, their media clock is not stopped. For visual streams, whether natural video or synthetic such as animation streams or Inline nodes, **mute** means that the visual texture remains unchanged; for audio streams, the audio is not played.

If the **enabled** field is set to TRUE the **MediaControl** node controls the stream object it refers to. More than one **MediaControl** node may be used to control a stream object within the same stream. At most one of these **MediaControl** nodes shall be enabled at any time.

If one of these **MediaControl** nodes becomes enabled, the **enabled** field of all other **MediaControl** nodes that refer to the same stream shall automatically be set to FALSE.

If the **enabled** field is set to FALSE the **MediaControl** node shall cease to control the play back and muting of the controlled stream object, however, **preRoll** shall still be evaluated. If the controlled stream object is playing when **enabled** is set to FALSE and no other **MediaControl** node takes control of the stream, the stream object shall continue playing as if it were still controlled by the disabled **MediaControl** node.

Only one MediaControl node shall refer to any of the set of media streams that are associated to a single object time base.

Note – MediaControl affects the OTB of the controlled stream and therefore affects all the streams that are associated to the same OTB. Therefore changing play position, speed or direction of one stream will correspondingly affect all the active streams that are associated to the same OTB.

EXAMPLE — The following scene shows how to control a video from a MediaControl the Script also receives the current video time and can trigger events according to the video time: In the example, when the TouchSensor is touched, the video will play the section ranging between 10 to 20 seconds from the start of the sequence.

```
[....]
Shape {
    texture DEF M MovieTexture { url "od:5" }
    geometry BitMap{}
}
DEF MS MediaSensor {
    url "od:5"
}
MediaControl {
    url "od:5"
    mediaStartTime 10.0
    mediaStopTime 20.0
}
DEF T TouchSensor {}
DEF S Script {
    eventIn SFTime videoTime
    ...
}

ROUTE MS.mediaCurrentTime TO S.videoTime
ROUTE T.touchTime TO M.startTime
```

The following table lists values for various node fields in order to play, pause, and stop streams:

| Action | Node Values |
|---|--|
| Play stream from beginning to end. | mediaStartTime = 0 mediaStopTime = +1 |
| Play stream backwards from end to beginning | mediaStartTime = +1 mediaStopTime = 0 mediaSpeed = -1.0 |
| Pause stream | stopTime = NOW in the controlled media node and mediaStartTime = -1 Or mediaSpeed = 0 |
| Play stream from current position to end | mediaStartTime = -1 mediaStopTime = +1 |
| Play stream backwards from current position to beginning | mediaStartTime = -1 mediaStopTime = 0 mediaSpeed = -1.0 |
| Play stream from 10 seconds past start to 20 seconds past start at half speed | mediaStartTime = 10 mediaStopTime = 20 mediaSpeed = 0.5 |
| Play stream backwards from 20 seconds past start to 10 seconds past start at double speed | mediaStartTime = 20 mediaStopTime = 10 mediaSpeed = -2.0 |
| Play stream forwards from current position to 10 seconds past start | mediaStartTime = -1 mediaStopTime = 10 |

9.4.2.75 MediaSensor

9.4.2.75.1 Node interface

MediaSensor {

| | | | |
|--------------|----------|-----------------------|-----|
| exposedField | MFString | url | [] |
| eventOut | SFTime | mediaCurrentTime | |
| eventOut | SFTime | streamObjectStartTime | |
| eventOut | SFTime | mediaDuration | |
| eventOut | SFBool | isActive | |
| eventOut | MFString | info | |

}

NOTE — For the binary encoding of this node see Annex H.6.5.

9.4.2.75.2 Functionality and semantics

The MediaSensor node monitors the availability and presentation status of one or more stream objects.

The **url** field identifies a list of stream objects monitored by the MediaSensor node. All the stream objects in the **url** field shall belong to the same media stream.

A stream object is considered to be available when any of its composition units is available in the composition buffer and is due for composition at that time. A stream object is considered to be no longer available when it is paused or stopped. A stream object is considered to “become available” when it “is available” for the first time. When there are several monitored stream objects available at the same time, the fields in the MediaSensor convey information about the stream object that became available last. If the stream that last became available becomes inactive, the MediaSensor node shall convey information about the first active stream in its **url** field.

The **isActive** event sends a TRUE value each time one of the monitored stream objects referred by the **url** field becomes available, and a FALSE value when all of them become not available.

Whenever a new composition unit is due for composition, a **mediaCurrentTime** event is sent and indicates the media time of that composition unit within the stream object.

The **streamObjectStartTime** event conveys the start of the stream object within a stream, relative to media time zero of the whole stream.

The **mediaDuration** event conveys the duration of the stream object in seconds. It is set to -1 if this duration is unknown.

The **info** event conveys information about the stream object that is currently monitored. Its first element identifies the stream object using the same syntax as in the **url** field.

The **streamObjectStartTime**, **mediaDuration** and **info** events are triggered when any stream object in the **url** field becomes available.

“

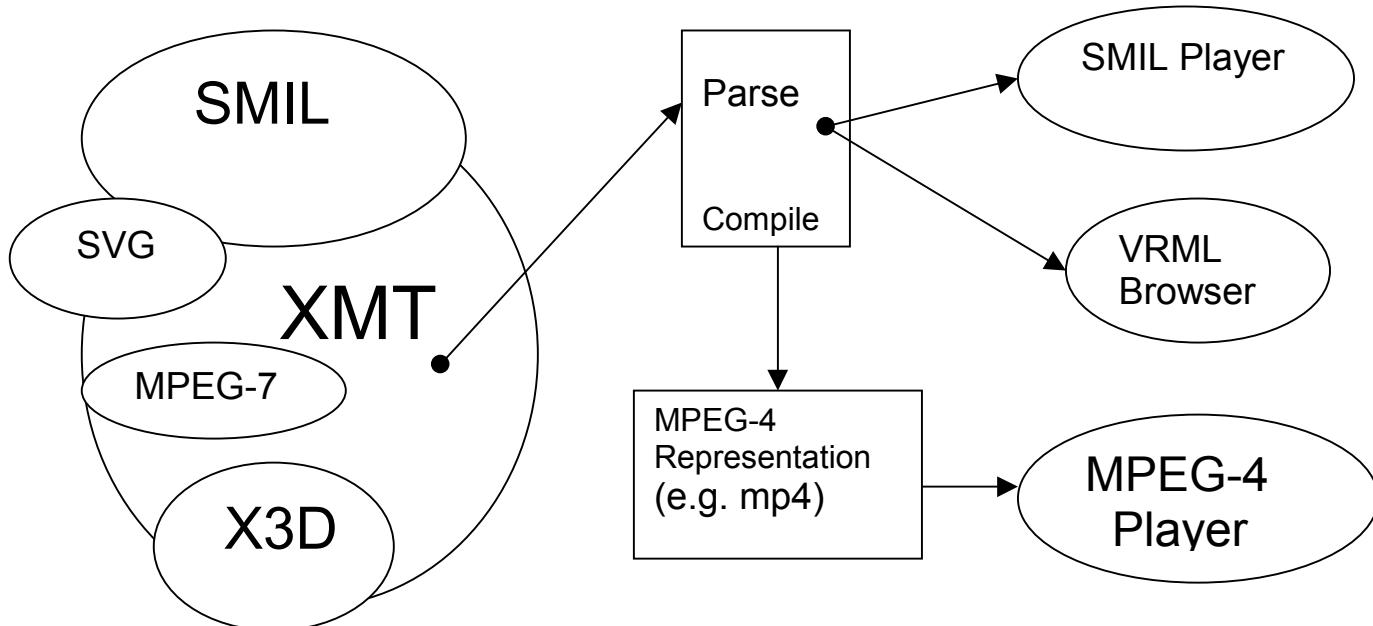
Insert the following 4 clauses before clause 14 (Syntactic Description Language). Rerumber existing clauses 14 and 15, to 18 and 19 respectively.

14 Overview of the XMT Framework

The Extensible MPEG-4 Textual format (XMT) is a framework for representing MPEG-4 scene description using a textual syntax. The XMT allows the content authors to exchange their content with other authors, tools or service providers, and facilitates interoperability with both the Extensible 3D (X3D) being developed by the Web3D and the Synchronized Multimedia Integration Language (SMIL) from the W3C.

14.1 Interoperability of XMT

The XMT format can be interchangeable between SMIL players, VRML players, and MPEG-4 players. The format can be parsed and played directly by a W3C SMIL player, preprocessed to Web3D X3D and played back by a VRML player, or compiled to an MPEG-4 representation such as mp4, which can then be played by an MPEG-4 player. See below for a graphical description of interoperability of the XMT.



14.2 Two-tier Architecture: XMT-A and XMT-Ω Formats

The XMT framework consists of two levels of textual syntax and semantics: the XMT-A format and the XMT-Ω format, which we will abbreviate by A and Ω, respectively, and use them interchangeably where there is no confusion.

The XMT-A is an XML-based version of MPEG-4 content, which contains a subset of the X3D. Also contained in XMT-A is an MPEG-4 extension to the X3D to represent MPEG-4 specific features. The XMT-A provides a straightforward, one-to-one mapping between the textual and binary formats.

The XMT-Ω is a high-level abstraction of MPEG-4 features designed based on the W3C SMIL. The XMT provides a default mapping from Ω to A, for there is no deterministic mapping between the two, and it also provides content authors with an escape mechanism from Ω to A.

In addition an XMT-C (Common) section contains the definition of elements and attributes that may be used within either XMT-A or XMT-Ω.

15 XMT-A Format

15.1 Introduction

This section contains the XMT-A format definition that has the goals of representing binary constructs in a textual format, providing an optional one-to-one deterministic mapping to binary coding.

15.2 XMT-A Document structure

An XMT-A document has a single optional <Header> element followed by a single <Body> element. The <Header> element contains zero or more <meta> elements and also contains the MPEG-4 specific element for the <InitialObjectDescriptor>.

15.2.1 Identifiers and forward references within a document instance

An XMT-A document instance is comprised of a set of elements to represent MPEG-4 systems streams as a textual format. In the textual format the order of the elements in the document is not necessarily the same order as the corresponding binary constructs in the streams. There is however an understood mapping. See the section on XMT-A Deterministic mapping for more details.

So elements in the document are timed using a <par> element with a begin attribute to specify the time. These <par> elements may also be nested, and the timing of the nested <par> elements is relative to its parent (as in fact are the top level <par>s because they can be considered to be nested in the topmost implicit par that comprises the body of the document that begins at 0s). To create the binary streams the elements are sorted in temporal order maintaining the document order of any elements that are for the same time. Since the elements may be out of order the question is are forward references allowed of identifiers that are mapped to binary streams.

The answer is that forward references within the document are permitted. However within a single stream, if as the elements are sorted in time then any forward references that remain must not be in violation of the MPEG-4 Systems specification if forward references are not permitted for that stream. I.e. if the temporal sorting does not eliminate forward references and this causes an illegal stream due to unknown Ids, because of the forward references, then some alternate representation should be sought. And across streams forward references in the document are also permitted if the coding leads to valid MPEG-4 system streams.

15.3 XMT-A Representation of Nodes

15.3.1 Overview

This section provides a description of the XMT-A textual representation of MPEG-4 nodes.

15.3.2 XMT-A node elements

15.3.2.1 MPEG-4 node/field to XMT-A element/attribute mapping algorithm

The following algorithm is used to convert MPEG-4 nodes and fields to XMT-A elements and attributes.

1. Each node is converted to an XMT-A element, with its name preserved.
2. For each field of a node
 - a. If the field type is a node, i.e., the field can contain one or more children nodes, then the field is converted to an XMT-A element, with the element name identical to the field name. This element will appear as the child element.
 - b. If the field type is non-node and is a plain Field or an exposedField, then the field is made into an attribute of the element, preserving its name. (Fields with eventIn and eventOut types are omitted as they are not encoded and these cannot usefully be attributes of the element.)

An exception to the above rule for node/non-node field conversion is for the <Conditional> node, where the buffer field, although a non-node field, is converted to an element so that it can contain one or more BIFS command elements in this XML representation .

A field without a default value is optional. Fields with MPEG-4 default binary values are given default XML attributes with the same values.

When numerical multiple value fields are to be encoded using predictiveMFField coding, the node shall have a sequence of <PredictiveField> elements as children, one for each encoded field.

15.3.2.2 Common attributes and elements

Optional DEF and USE attributes are present on all XMT-A node elements. XMT-A adds the following optional common attributes:

- binaryID for deterministic binary encoding,
- DEF to code id as name,

15.3.2.3 Element and attribute type classifications

Node elements and field attribute types will be classified according to MPEG-4 system node types.

15.3.3 Schema and XMT-A examples

Given the algorithm described above, MPEG-4 nodes can easily be converted into XMT-A. This section provides some examples to illustrate the representation. The full set of nodes from clause 9 can be converted this way. The Schema for XMT-A, containing the full set of nodes, can be found in an external annex to this document in a file named **xmt-a.xsd**.

The following example shows the MPEG-4 node Material converted to the XMT-A element <Material>. The Material node has no fields that are nodes and so all its fields have become attributes and DEF/USE is included as a predefined attribute group. The IS subelement is used when the node is part of a PROTO declaration.

```
<element name="Material">
  <complexType>
    <sequence>
      <element ref="xmta:IS" minOccurs="0" />
    </sequence>
    <attribute name="ambientIntensity" type="xmta:SFFloat" use="optional" default="0.2" />
    <attribute name="diffuseColor" type="xmta:SFCOLOR" use="optional" default="0.8 0.8 0.8" />
    <attribute name="emissiveColor" type="xmta:SFCOLOR" use="optional" default="0 0 0" />
    <attribute name="shininess" type="xmta:SFFloat" use="optional" default="0.2" />
    <attribute name="specularColor" type="xmta:SFCOLOR" use="optional" default="0 0 0" />
    <attribute name="transparency" type="xmta:SFFloat" use="optional" default="0" />
    <attributeGroup ref="xmta:DefUseGroup" />
  </complexType>
</element>
```

The DefUseGroup defines the attributes DEF, USE and binaryID. DEF is a string that contains a symbolic ID. USE is a string that refers to a node that has the matching symbolic ID. The type of the element with the USE attribute shall match the type of the element having the matching DEF symbolic ID. The attribute binaryID is an integer defining the binary nodeID to be used when encoding the scene in BIFS.

Some examples of use of the above definition are:

```
<Material ambientIntensity="0.6" emissiveColor="1.0 0.1 0.78"/>

<Material DEF="Ablue" emissiveColor="0.0 0.1 0.88"/>

<Material USE="Ablue"/>
```

The following example shows the MPEG-4 node OrderedGroup converted to the XMT-A element <OrderedGroup>. The OrderedGroup node has the children fields that is of type multiple nodes and so that field is converted to an element whilst its other field (order) has become an attribute.

```
<element name="OrderedGroup">
  <complexType>
    <all>
      <element ref="xmta:IS" minOccurs="0" />
      <element name="children" minOccurs="0" form="qualified">
        <complexType>
          <group ref="xmta:SF3DnodesType" minOccurs="0" maxOccurs="unbounded" />
        </complexType>
      </element>
    </all>
  </complexType>
</element>
```

```
</element>
</all>
<attribute name="order" type="xmta:MFFloat" use="optional" />
<attributeGroup ref="xmta:DefUseGroup" />
</complexType>
</element>
```

An example of its use (the Shapes are incomplete for simplicity) is:

```
<OrderedGroup order="1.2 6.5">
  <children>
    <Shape>...<Shape/>
    <Shape>...<Shape/>
  </children>
</OrderedGroup>
```

15.4 XMT-A Routing

15.4.1 <ROUTE>

15.4.1.1 Description

The <ROUTE> element is the XMT-A representation of the ROUTE. The optional id attribute names the ROUTE and allows the ROUTE to be deleted or replaced at a later time by referring to it via the atRoute attribute of BIFS Commands.

```
<element name="ROUTE">
  <complexType>
    <attribute name="DEF" type="ID" use="optional"/>
    <attribute name="binaryID" type="int" use="optional"/>
    <attribute name="fromNode" type="IDREF" use="required"/>
    <attribute name="fromField" type="xmta:fieldName" use="required"/>
    <attribute name="toNode" type="IDREF" use="required"/>
    <attribute name="toField" type="xmta:fieldName" use="required"/>
  </complexType>
</element>
```

<ROUTE>s can be placed inside the <Scene> element before the closing </Scene>. <ROUTE>s cannot be included inside other elements of the scene.

15.5 PROTOs in XMT-A

15.5.1 PROTO Declaration

The <ProtoDeclare> element is the equivalent of the PROTO Declaration defined in 9.3.7.2.2

```
<ProtoDeclare name="" protoID="">
  <field .../> // as many as needed
  ...// then nested ProtoDeclare(s)
  ...// then nodes
  ...// then ROUTEs
</ProtoDeclare>
```

15.5.2 PROTO Instance

```
<ProtoInstance name="">
  <fieldValue .../> // as many as needed
</ProtoInstance>
```

15.5.3 field

The element <field>, subelement of <ProtoDeclare>, allows the definition of the PROTO declaration interface, as defined in 9.3.7.2.3.

```
<field name="" type="" vrlm197hint="" [typedvalue]="">
  <InterfaceCodingParameters quantCategory="" animCategory="" nbBits="">
```

```

position3Dmin="" position3Dmax=""
position2Dmin="" position2Dmax=""
drawOrderMin="" drawOrderMax=""
colorMin="" colorMax=""
textureCoordinateMin="" textureCoordinateMax=""
angleMin="" angleMax=""
scaleMin="" scaleMax=""
keyMin="" keyMax=""
sizeMin="" sizeMax=""

/&
...// SFNode or MFNode default value here
</field>

```

Name is the name of the field, type is an enumerated value from Table 2, vrm197hint is an enumerated value from Table 1. If the field has a default value which is neither a node or a set of nodes, the value is specified as an attribute. The name of the attribute is specific to the type of the field, as shown in Table 3.. This type-specific attribute name allows efficient type-checking of the default value with XML Schema. The InterfaceCodingParameters element allows the specification of the BIFS element of the same name described in 9.3.7.2.7.

Table 1 – vrm197hint values

| <i>scope of the field</i> | <i>vrm197hint value</i> |
|---------------------------|-------------------------|
| eventIn | eventIn |
| eventOut | eventOut |
| field | field |
| exposedField | exposedField |

Table 2 – type values

| <i>field type</i> | <i>type value</i> |
|-------------------|---------------------|
| SFBool | Boolean |
| MFBool | Booleans |
| SFColor | Color |
| MFCColor | Colors |
| SFFloat | Float |
| MFFloat | Floats |
| SFImage | Image |
| MFIImage | Images |
| SFInt32 | Integer |
| MFInt32 | Integers |
| SFNode | Node |
| MFNode | Nodes |
| SFRotation | Rotation |
| MFRotation | Rotations |
| SFString | String |
| MFString | Strings |
| SFTime | Time |
| MFTime | Time |
| SFVec2f | Vector2 |
| MFVec2f | Vector2Array |
| SFVec3f | Vector3 |
| MFVec3f | Vector3Array |

Table 3 – typeToAttributeName correspondance

| <i>type of field</i> | <i>name of value attribute</i> |
|----------------------|--------------------------------|
| SFBool | booleanValue |
| MFBBool | booleanArrayValue |
| SFColor | colorValue |
| MFCColor | colorArrayValue |
| SFFloat | floatValue |
| MFFloat | floatArrayValue |
| SFImage | imageValue |
| MFImage | imageArrayValue |
| SFInt32 | integerValue |
| MFInt32 | integerArrayValue |
| SFNode | nodeValue |
| MFNNode | nodeArrayValue |
| SFRotation | rotationValue |
| MFRotation | rotationArrayValue |
| SFString | stringValue |
| MFString | stringArrayValue |
| SFTime | timeValue |
| MFTime | timeArrayValue |
| SFVec2f | vector2Value |
| MFVec2f | vector2ArrayValue |
| SFVec3f | vector3Value |
| MFVec3f | vector3ArrayValue |

15.5.4 fieldValue

The element <fieldValue>, subelement of <ProtoInstance> allows the definition of the PROTO instance interface.

```
<fieldValue name="" [typedvalue]="">
  ...// SFNode or MFNode value here
</fieldValue>
```

Name is the name of the field, type is an enumerated value from Table 2, vrml97hint is an enumerated value from Table 1. If the field has a default value which is neither a node or a set of nodes, the value is specified as an attribute. The name of the attribute is specific to the type of the field, as shown in Table 2. This type-specific attribute name allows efficient type-checking of the value with XML Schema.

15.5.5 IS

Inside a PROTO declaration, any value can be Ised to one of the fields in the PROTO interface. This IS link is specified with an <IS> element, which can only appear inside <ProtoDeclare>, but may appear in any node, <field> and <fieldValue> element. The <IS> element is a wrapper for one or more IS links. Each IS link is specified through a <connect> element:

```
<IS>
  <connect nodeField="" protoField="" /> // as many as needed
</IS>
```

nodeField refers to the name of the field of the parent node element. ProtoField refers to the name of the field of one of the parent proto declaration interface which should be connected to nodeField. A node field can be connected to many proto fields. A proto field can be connected to many node fields.

15.5.6 Example of PROTO in XMT-A

```
<ProtoDeclare name="P0" protoID="0">
  <field name="field0" type="Vector2" vrml97Hint="field" vector2Value="0.0 0.0"/>
  <Transform2D>
    <IS>
      <connect nodeField="translation" protoField="field0"/>
    </IS>
  <children>
```

```

<Shape>
  <geometry>
    <Rectangle size="0.2 0.2"/>
  </geometry>
</Shape>
</children>
</Transform2D>
</ProtoDeclare>

<ProtoInstance name="P0">
  <fieldValue name="field0" vector2Value="0.0 -0.6"/>
</ProtoInstance>

```

15.6 XMT-A Timing

The XMT-A uses one of the SMIL time containers, the `<par>` element, to group multiple commands.

15.6.1 `<par>`

The XMT-A allows only the “begin” attribute on the `<par>` element to specify the execution (begin) time of commands. Moreover `<par>` elements can also contain other `<par>` elements and for the nested `<par>` elements their begin time is relative to the parent time container. There is an implied top level `<par begin="0.0">`. The `<par>` elements need not appear ordered in time, indeed nesting of `<par>` elements will often preclude this. Begin times shall be ≥ 0.0 seconds. The attribute begin has an SFTime type to maintain uniformity with other time fields, in MPEG-4 node elements such as `<TimeSensor>` and `<MovieTexture>`, within the scene.

The `<par>` element may contain

- `<par>`
- BIFS Commands
- BIFS Anim
- Object Descriptor Commands
- IPMP Messages
- OCI Events
- MPEG-J Stream Headers

For a given BIFS stream, all BIFS commands, to be executed at a given time will be coded into a single CommandFrame (and hence a single AU) in the order the commands appear in the document.

All OD commands, for a given OD stream, to be executed at a given time will be coded into a single AU in the order the commands appear in the document.

All IPMP messages, for a given IPMP elementary stream, to be executed at a given time will be coded into a single AU in the order the messages appear in the document.

All OCI Events messages, for a given OCI elementary stream, to be executed at a given time will be coded into a single AU in the order the events appear in the document.

```

<par begin="" atES_ID="">
  <!-- Any number of commands/messages/events and/or <par> elements -->
</par>

```

The `atES_ID` attribute indicates the destination of the commands and descriptors which are children of the `par` element. It specifies a symbol which is the ID of the elementary stream into which the commands and descriptors should be encoded. In the case of conflicting `atES_ID` values, the attribute closest to the command or descriptor takes precedence.

15.7 XMT-A Representation of BIFS Commands

15.7.1 Overview

This section provides a detailed description of the XMT-A encoding of the MPEG-4 BIFS commands. Commands in BIFS are timed using `<par>` element construct.

There are three basic BIFS commands in XMT-A: `<Insert>`, `<Delete>`, `<Replace>`. The MPEG-4 ReplaceScene binary command is captured in XMT-A with `<Replace> <Scene>... </Scene></Replace>`. `<Insert>`, `<Delete>` and

<Replace> commands can be used on nodes, values in multiple value fields, or routes. In addition <Replace> can act on a whole multiple value field. <Replace> <Scene> replaces the entire scene – both nodes and routes.

15.7.2 <Insert>

Insert command provides for node, Indexed value and Route insertion. For Insert atField defaults to value ‘children’ and position defaults to value ‘END’ making it easy to add a Node to a group.

```
<Insert atES_ID="" atNode="" atRoute=""  
       atField="children" position="BEGIN | END | n" value="">  
   <!--Nodes (including sub-trees) may go here and/or Routes-->  
</Insert>
```

The atES_ID attribute indicates the destination of the command. It specifies a symbol which is the ID of the elementary stream into which the command should be encoded. In the case of conflicting atES_ID values, the attribute closest to the command or descriptor takes precedence.

Whenever multiple nodes are inserted, the default for each position is END. If the position attribute contains more values than there are nodes or values to be inserted, then the extra position values are ignored. If the position attribute is not present or contains not enough values, the remaining nodes are inserted at END by default.

15.7.2.1 Insert Node

This is the Insert Node version of the Insert command. When atField="children" (defaulted if attribute not present) the command will be encoded as BIFS Update for Insert Node by nodeId. When atField is any other MFNode field then it will be encoded as BIFS Update for Insert by IndexedValue.

```
<Insert atNode="" atField="children" position="BEGIN | END | n">  
   <!--Node (tree) goes here -->  
</Insert>
```

The following are examples of Insert used to insert a node

- Inserts a new sub-tree at the END of a group

```
<Insert atNode="MyGroup">  
  <Group>  
    <children>...</children>  
  </Group>  
</Insert>
```

- the following is equivalent to above example (atField="children" is default)

```
<Insert atNode="MyGroup" atField="children">  
  <Group>  
    <children>...</children>  
  </Group>  
</Insert>
```

- Inserts a new shape at the END of a group (geometry and appearance content omitted for clarity)

```
<Insert atNode="MyGroup">  
  <Shape>  
    <geometry>...</geometry>  
    <appearance><Appearance DEF="MyShapeStyle">...</appearance>  
  </Shape>  
</Insert>
```

- Inserts 2 new shapes, one at BEGIN and other at the END of a group

```
<Insert atNode="MyGroup" position="BEGIN, END">
  <Shape DEF="MyRect">
    <geometry>...</geometry>
    <appearance>...</appearance>
  </Shape>
  <Shape USE="MyRect"/>
</Insert>
```

15.7.2.2 Insert Indexed Value

This is the InsertIndexedValue version of Insert for simple non-Node fields

```
<Insert atNode="" atField="" position="BEGIN | END | n" value="" />
```

The following are examples of Insert used to insert simple field values (non-Node values)

- Inserts a new colorIndex value 6 at the END of the colorIndex field

```
<Insert atNode="MyIndexedLineSet2D" atField="colorIndex" value="6" />
```

- Inserts new colorIndex values 3,3,5,4,2 at positions 2,7,BEGIN, END and 4. Note that position 7 is the new position after the first value has been inserted at position 2 etc. Inserts are done in the order listed
The following command will be encoded as 5 BIFS Update commands for IndexedValue field insertion)

```
<Insert atNode="MyIndexedLineSet2D" atField="colorIndex"
       position="2 7 BEGIN END 4"
       value="3 3 5 4 2" />
```

15.7.2.3 Insert Route

This is InsertRoute version of Insert

```
<Insert>
  <ROUTE fromNode="" fromField="" toNode="" toField="" />
</Insert>
```

The following are examples of Insert used to insert a Route

- Inserts a ROUTE without an ID

```
<Insert>
  <ROUTE fromNode="WhiteRect" fromField="emissiveColor"
         toNode="Acircle"          toField="emissiveColor" />
</Insert>
```

- Inserts a ROUTE with an ID

```
<Insert>
  <ROUTE DEF="myROUTE" fromNode="WhiteRect" fromField="emissiveColor"
          toNode="Acircle"          toField="emissiveColor" />
</Insert>
```

15.7.3 <Delete>

Delete command provides for node, Indexed value and Route deletion. For Delete atField defaults to value 'children' but position has no default.

```
<Delete atES_ID="" atRoute="" atNode=""
        atField="children" position="BEGIN | END | n" />
```

Attributes atNode and atRoute are exclusive.

The atES_ID attribute indicates the destination of the command. It specifies a symbol which is the ID of the elementary stream into which the command should be encoded. In the case of conflicting atES_ID values, the attribute closest to the command or descriptor takes precedence.

15.7.3.1 Delete Node

This is the Delete Node version of the Delete command.

```
<Delete atNode="" />
```

The following is an example of Delete used to delete a node

- Deletes a DEF'd node

```
<Delete atNode="MyIndexedLineSet2D" />
```

15.7.3.2 Delete Indexed Value

This is the DeleteIndexedValue version of Delete for Nodes and simple non-Node fields

```
<Delete atNode="" atField="" position="BEGIN | END | n" />
```

The following are examples of Delete used to delete both simple field values (non-Node values) and Nodes

- Delete colorIndex value at the END of the colorIndex field

```
<Delete atNode="MyIndexedLineSet2D" atField="colorIndex" position="END" />
```

- Deletes colorIndex values at positions 2,7,BEGIN, END and 4. Note that position 7 is the new position after the first value has been deleted at position 2 etc. Deletes are done in the order listed.

```
<Delete atNode="MyIndexedLineSet2D" atField="colorIndex"
       position="2 7 BEGIN END 4" />
```

- Deletes 2 colors (nodes), one at pos 7 and one at the END of the color field.

```
<Delete atNode="MyIndexedLineSet2D" atField="color" position="7 END" />
```

15.7.3.3 Delete Route

This is the Delete Route version of Delete

```
<Delete atRoute="" />
```

The following are examples of Delete used to delete Routes

- Deletes a named Route

```
<Delete atRoute="BlueRoute" />
```

15.7.4 <Replace>

Replace command provides for node, field, Indexed value, Route and Scene replacement. For Replace neither atField nor position have default values.

```
<Replace atES_ID="" atRoute="" atNode=""
         atField="children" position="BEGIN | END | n" value="">
    <!--Nodes (including sub-trees) may go here and/or Routes -->
</Replace>
```

Attributes atNode and atRoute are exclusive.

The atES_ID attribute indicates the destination of the command. It specifies a symbol which is the ID of the elementary stream into which the command should be encoded. In the case of conflicting atES_ID values, the attribute closest to the command or descriptor takes precedence.

Whenever multiple nodes are replaced, the default for each position is END. If the position attribute contains more values than there are nodes or values replaced, then the extra position values are ignored. If the position attribute is not present or contains not enough values, the remaining nodes or values are replaced at END by default.

15.7.4.1 Replace Node

This is the Replace Node version of the Replace command.

```
<Replace atNode="" />
```

The following are examples of Replace used to replace a node

- Replaces existing MyGroup node with new sub-tree

```
<Replace atNode="MyGroup">
  <Group>
    <children>...</children>
  </Group>
</Replace>
```

- Replaces existing shape MyRect node with new one MyCircle

```
<Replace atNode="MyRect">
  <Shape DEF="MyCircle">
    <geometry>...</geometry>
    <appearance><Appearance DEF="MyShapeStyle">...</appearance>
  </Shape>
</Replace>
```

Note: Unlike Insert it makes no sense to allow multiple specification of Nodes here as they would all replace the same target.

15.7.4.2 Replace Field

This is the Replace Field version of the Replace command. When position attribute is not specified the entire field is to be replaced.

```
<Replace atNode="" atField=" value="">
  <!--A Node may go here →
</Replace>
```

The following are examples of Replace used to replace a node

- Replaces colorIndex (replace entire MF field)

```
<Replace atNode="MyIndexedLineSet2D" atField="colorIndex"
  value= "6 5 6 7 7 2 1" />
```

- Replaces emissiveColor field (replace SF field)

```
<Replace atNode="MyMaterial" atField="emissiveColor"
  value= "1.0 0.5 0.2" />
```

- Replaces color field (replace SF field or type SFNode)

```
<Replace atNode="MyIndexedFaceSet" atField="color">
  <Color color="1.0 0.5 0.9 0.8 0.5 0.1 0.5 0.5 0.5">
</Replace>
```

Note: Specifying multiple field positions makes no sense (similar comment at end of Replace Node above)

15.7.4.3 Replace Indexed Value

This is the Replace Indexed Value version of the Replace command. Position attribute is specified and hence an indexed value replacement in an MFField is replaced.

```
<Replace atNode="" atField=" position="BEGIN | END | n" value="" />
  <!--Nodes may go here →
</Replace>
```

The following are examples of Replace used to replace an indexed value

- Replaces colorIndex value at the END of the colorIndex field to 6

```
<Replace atNode="MyIndexedLineSet2D" atField="colorIndex" position="END"
  value="6" />
```

- Replaces colorIndex values 3,3,5,4,2 at positions 2,7,BEGIN, END and 4. Replaces are done in the order listed.

```
<Replace atNode="MyIndexedLineSet2D" atField="colorIndex"
  position="2 7 BEGIN END 4"
  value="3 3 5 4 2" />
```

- This is still a replace indexed value (encodes to 5 IndexedValue BIFS Replace commands) even if the field had five elements and this is replacing them all. To specify a complete field replacement the position should be omitted and then a single BIFS Replace Field command would be encoded.

```
<Replace atNode="MyIndexedLineSet2D" atField="colorIndex"
  position="0 1 2 3 4"
  value="3 3 5 4 2" />
```

- Replaces existing node in MySwitch choice field at position 5 with new one

```
<Replace atNode="MySwitch" atField="choice" position="5">
  <Shape>
    <geometry><Circle radius="100"/></geometry>
    <appearance>...</appearance>
  </Shape>
</Replace>
```

- Replaces existing node in MyGroup choice field at position 3 and 7 with new ones

```
<Replace atNode="MyGroup" atField="children" position="3, 7">
  <Shape>
    <geometry><Circle radius="10"/></geometry>
    <appearance>...</appearance>
  </Shape>
  <Shape>
    <geometry><Rectangle width="10" heiht="70"/></geometry>
    <appearance>...</appearance>
  </Shape>
</Replace>
```

15.7.4.4 Replace Route

This is the Replace Route version of the Replace command.

```
<Replace atRoute="">
  <ROUTE fromNode="" fromField="" toNode="" toField="" />
</Replace>
```

The following are examples of Replace used to replace an indexed value

- Replaces existing route ‘ColorRoute’ with a new route fromNode/Field to Node/Field.

```
<Replace atRoute="ColorRoute">
  <ROUTE fromNode="WhiteRect"      fromField="emissiveColor"
        toNode="ACircle"          toField="emissiveColor"/>
</Replace>
```

15.7.4.5 Replace Scene

This is the Replace Scene version of the Replace command.

```
<Replace>
  <Scene useNames="true|false">
    <!--Nodes followed by -->
    <!--ROUTES go here -->
  </Scene>
</Replace>
```

The following are examples of Replace used to replace a scene

- Replaces Scene.

```
<Replace>
  <Scene>
    <Group>
      <children>
        <Shape DEF="MyRect">
          <geometry>...</geometry>
          <appearance>...</appearance>
        </Shape>
        <Shape USE="MyRect" />
      </children>
    </Group>
    <ROUTE DEF="MatColorRoute"
            fromNode="Mat1" fromField="emissiveColor"
            toNode="Mat2" toField="emissiveColor" />
    <ROUTE fromNode="LineProp1" fromField="lineColor"
           toNode="LineProp2" toField="lineColor" />
  </Scene>
</Replace>
```

ROUTES may appear only appear after nodes in a list immediately before the closing `</Scene>`. When encoded to MPEG-4 the ROUTES shall be included in the ReplaceScene in the order they appear in the document.

Note that MPEG-4 requires the top-level node to be Group, OrderedGroup, Layer2D or Layer3D. The author should ensure that the outermost node in a replace scene conforms to this requirement.

15.8 XMT-A Representation of Object Descriptors

15.8.1 Overview

Object descriptor is an MPEG-4 concept described in the Systems specification. The purpose of the object descriptors is to identify and describe elementary streams and to associate them appropriately to an audio-visual scene description. Object descriptors serve to gain access to ISO/IEC 14496 content.

An object descriptor is a collection of one or more elementary stream descriptors that provide the configuration and other information for the streams that relate to either an audio-visual object or a scene description. Object descriptors are themselves conveyed in elementary streams. Each object descriptor is assigned an identifier (object descriptor ID), which is unique within a defined name scope. This identifier is used to associate audio-visual objects in the scene description with a particular object descriptor, and thus the elementary streams related to that particular object.

Elementary stream descriptors include information about the source of the stream data, in the form of a unique numeric identifier (the elementary stream ID) or a URL pointing to a remote source for the stream. Elementary stream descriptors also include information about the encoding format, configuration information for the decoding process and the sync layer packetization, as well as quality of service requirements for the transmission of the stream and intellectual property identification. Dependencies between streams can also be signaled within the

elementary stream descriptors. This functionality may be used, for example, in scalable audio or visual object representations to indicate the logical dependency of a stream containing enhancement information, to a stream containing the base information. It can also be used to describe alternative representations for the same content (e.g. the same speech content in various languages).

To convert MPEG-4 descriptors to an XML representation the following guidelines were followed. The descriptor is first converted to an element with the same name. Then for simple fields (e.g bit(5), bit(8) etc) these are converted to attributes taking the value of the simple field, unless they are part of an if construct. In the latter case the field is converted to an attribute of an element having the name of the if condition flag. For arrays of descriptors e.g ES_Descriptor esDescr[1..255], these have been converted to an element having the name as the array and containing descriptors of the given type.

15.8.2 <Object Descriptor>

```
<ObjectDescriptor
  objectDescriptorID=""
  binaryID=""
  <URL URLstring="">
  <Descr>
    <esDescr>...</esDescr>
    <ociDescr>...</ociDescr>
    <ipmpDescrPtr>...</ipmpDescrPtr>
  </Descr>
  <extDescr>...</extDescr>
</ObjectDescriptor>
```

15.8.2.1 Description

The <ObjectDescriptor> element is the XMT-A representation of the ObjectDescriptor as described in subclause 8.6.3.

The XMT-A Schema allows either the <URL> element or the <Descr> element and corresponds to the if (URL_Flag) construct. The <URL> element contains the URLstring and if present the descriptor will be binary encoded with the URL_Flag field bit set to 1 and the URLlength attribute set to the length of the URLstring. If the <Descr> element is present then URL_Flag field bit will be encoded as 0.

If the form of the url attribute in the media element is url="od:MyOdIdentifier", ie. The url starts with **od:** or **od://** then the url shall be coded as an Odid otherwise it shall be coded as a string (urlValue). The form as above assumes the SF/MFString representation. The part after **od:** or **od://** is in fact the objectDescriptorID (its id) of an Object Descriptor.

Example:

```
< AudioSource url="od://PanelAudio"/>

<ObjectDescriptor objectDescriptorID="PanelAudio">
  .
  .
</ObjectDescriptor>
```

15.8.3 <InitialObjectDescriptor>

```
<InitialObjectDescriptor
  objectDescriptorID=""
  binaryID=""
  <URL URLstring="" />
  <Profiles
    ODProfileLevelIndication="None"
    sceneProfileLevelIndication="Simple2D_L1"
    audioProfileLevelIndication="Unspecified"
    visualProfileLevelIndication="254"
    graphicsProfileLevelIndication="254"
    includeInlineProfileLevelFlag="true|false" />
```

```

<Descr>
  <esDescr>...</esDescr>
  <ociDescr>...</ociDescr>
  <ipmpDescrPtr>...</ipmpDescrPtr>
</Descr>
<extDescr>...</extDescr>
</InitialObjectDescriptor>

```

15.8.3.1 Description

The `<InitialObjectDescriptor>` element is the XMT-A representation of the `InitialObjectDescriptor` as described in subclause 8.6.4.

The `InitialObjectDescriptor` is a variation of the `ObjectDescriptor` specified in the previous subclause that allows to signal profile and level information for the content referred by it. It shall be used to gain initial access to ISO/IEC 14496 content.

The XMT-A Schema allows either the `<URL>` element or the `<ProfDescr>` element and corresponds to the if (`URL_Flag`) construct. The `<URL>` element contains the `URLstring` and if present the descriptor will be binary encoded with the `URL_Flag` field bit set to 1 and the `URLlength` attribute set to the length of the `URLstring`. If the `<ProfDescr>` element is present then `URL_Flag` field bit will be encoded as 0.

The attributes `ODProfileLevelIndication`, `sceneProfileLevelIndication`, `audioProfileLevelIndication`, `visualProfileLevelIndication` and `graphicsProfileLevelIndication` take either a numeric value from 0 to 255 inclusive or a string corresponding to the enumerated values as follows:

| ODProfileLevelIndication | |
|---------------------------------|-----|
| Unspecified | 254 |
| None | 255 |

| sceneProfileLevelIndication | |
|------------------------------------|-----|
| Simple2D L1 | 1 |
| Simple2D L2 | 2 |
| Basic2D L1 | 11 |
| Core2D L1 | 12 |
| Core2D L2 | 13 |
| Advanced2D L1 | 14 |
| Advanced2D L2 | 15 |
| Advanced2D L3 | 16 |
| Main2D L1 | 17 |
| Main2D L2 | 18 |
| Main2D L3 | 19 |
| Unspecified | 254 |
| None | 255 |

| audioProfileLevelIndication | |
|------------------------------------|----|
| Main L1 | 1 |
| Main L2 | 2 |
| Main L3 | 3 |
| Main L4 | 4 |
| Scalable L1 | 5 |
| Scalable L2 | 6 |
| Scalable L3 | 7 |
| Scalable L4 | 8 |
| Speech L1 | 9 |
| Speech L2 | 10 |
| Synthesis L1 | 11 |
| Synthesis L2 | 12 |

| | |
|-------------------------------|-----|
| Synthesis L3 | 13 |
| HighQualityAudio L1 | 14 |
| HighQualityAudio L2 | 15 |
| HighQualityAudio L3 | 16 |
| HighQualityAudio L4 | 17 |
| HighQualityAudio L5 | 18 |
| HighQualityAudio L6 | 19 |
| HighQualityAudio L7 | 20 |
| HighQualityAudio L8 | 21 |
| LowDelayAudio L1 | 22 |
| LowDelayAudio L2 | 23 |
| LowDelayAudio L3 | 24 |
| LowDelayAudio L4 | 25 |
| LowDelayAudio L5 | 26 |
| LowDelayAudio L6 | 27 |
| LowDelayAudio L7 | 28 |
| LowDelayAudio L8 | 29 |
| NaturalAudio L1 | 30 |
| NaturalAudio L2 | 31 |
| NaturalAudio L3 | 32 |
| NaturalAudio L4 | 33 |
| MobileAudioInternetworking L1 | 34 |
| MobileAudioInternetworking L2 | 35 |
| MobileAudioInternetworking L3 | 36 |
| MobileAudioInternetworking L4 | 37 |
| MobileAudioInternetworking L5 | 38 |
| MobileAudioInternetworking L6 | 39 |
| Unspecified | 254 |
| None | 255 |

| VisualProfileLevelIndication | |
|-------------------------------------|----|
| Simple L3 | 1 |
| Simple L2 | 2 |
| Simple L1 | 3 |
| SimpleScalable L1 | 4 |
| SimpleScalable L2 | 5 |
| Core L2 | 6 |
| Core L1 | 7 |
| Main L4 | 8 |
| Main L3 | 9 |
| Main L2 | 10 |
| N-Bit L2 | 11 |
| Hybrid L2 | 12 |
| Hybrid L1 | 13 |
| BasicAnimatedTexture L2 | 14 |
| BasicAnimatedTexture L1 | 15 |
| ScalableTexture L3 | 16 |
| ScalableTexture L2 | 17 |
| ScalableTexture L1 | 18 |
| SimpleFaceAnimation L2 | 19 |
| SimpleFaceAnimation L1 | 20 |
| SimpleFBA L2 | 21 |
| SimpleFBA L1 | 22 |
| AdvancedRealTimeSimple L4 | 23 |
| AdvancedRealTimeSimple L3 | 24 |

| | |
|-----------------------------|-----|
| AdvancedRealTimeSimple L2 | 25 |
| AdvancedRealTimeSimple L1 | 26 |
| CoreScalable L3 | 27 |
| CoreScalable L2 | 28 |
| CoreScalable L1 | 29 |
| AdvancedCodingEfficiency L4 | 30 |
| AdvancedCodingEfficiency L3 | 31 |
| AdvancedCodingEfficiency L2 | 32 |
| AdvancedCoding EfficiencyL1 | 33 |
| AdvanceCore L2 | 34 |
| AdvanceCore L1 | 35 |
| AdvancedScalableTexture L3 | 36 |
| AdvancedScalableTexture L2 | 37 |
| AdvancedScalableTexture L1 | 38 |
| Unspecified | 254 |
| None | 255 |

| GraphicsProfileLevelIndication | |
|---------------------------------------|-----|
| Simple2D L1 | 1 |
| Simple2D+Text L1 | 2 |
| Simple2D+Text L2 | 3 |
| Core2D L1 | 4 |
| Core2D L2 | 5 |
| Advanced2D L1 | 6 |
| Advanced2D L2 | 7 |
| Unspecified | 254 |
| None | 255 |

15.8.4 <ES_Descriptor>

```
<ES_Descriptor
  ES_ID=""
  binaryID=""
  streamPriority=""
  dependsOn_ES_ID=""
  OCR_ES_ID="">
  <URL URLstring="" />
  <StreamSource>...</StreamSource>
  <decConfigDescr>...</decConfigDescr>
  <slConfigDescr>...</slConfigDescr>
  <ipiPtr>...</ipiPtr>
  <ipIDS>...</ipIDS>
  <ipmpDescrPtr>...</ipmpDescrPtr>
  <langDescr>...</langDescr>
  <qosDescr>...</qosDescr>
  <regDescr>...</regDescr>
  <extDescr>...</extDescr>
</ES_Descriptor>
```

15.8.4.1 Description

The <ES_Descriptor> element is the XMT-A representation of the ES_Descriptor as described in subclause 8.6.5. In addition a <StreamSource> element is included to identify the source media to be used for the stream. See XMT-A Elementary Stream Data section for further information on associating source data with elementary streams.

The <URL> element contains the URLstring and if present the descriptor will be binary encoded with the URL_Flag bit set to 1 and the URLlength attribute set to the length of the URLstring.

The <streamDependence> contains the attribute dependsOn_ES_ID and if the element is present then the binary encoding will have the streamDependenceFlag field bit set to 1 with the value of the dependsOn_ES_ID coded.

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The <OCRstream> contains the attribute OCR_ES_ID and if the element is present then the binary encoding will have the OCRstreamFlag field bit set to 1 with the value of the OCR_ES_ID coded.

15.8.5 <DecoderConfigDescriptor>

```
<DecoderConfigDescriptor
  objectTypeIndication="0"
  streamType=""
  upstream="false"
  bufferSizeDB="0"
  maxBitrate="0"
  avgBitrate="0">
  <decSpecificInfo>...</decSpecificInfo>
  <profileLevelIndicationIndexDescr>...</profileLevelIndicationIndexDescr>
</DecoderConfigDescriptor>
```

15.8.5.1 Description

The <DecoderConfigDescriptor> element is the XMT-A representation of the DecoderConfigDescriptor as described in subclause 8.6.6.

The attribute objectTypeIndication can take either a numeric value from 0 to 255 inclusive or a string corresponding to the enumerated values as follows:

| objectTypeIndication | |
|---------------------------------|-----|
| MPEG4Systems1 | 1 |
| MPEG4Systems2 | 2 |
| MPEG4Visual | 32 |
| MPEG4Audio | 64 |
| MPEG2VisualSimple | 96 |
| MPEG2VisualMain | 97 |
| MPEG2VisualSNR | 98 |
| MPEG2VisualSpatial | 99 |
| MPEG2VisualHigh | 100 |
| MPEG2Visual422 | 101 |
| MPEG2AudioMain | 102 |
| MPEG2AudioLowComplexity | 103 |
| MPEG2AudioScaleableSamplingRate | 104 |
| MPEG2AudioPart3 | 105 |
| MPEG1Visual | 106 |
| MPEG1Audio | 107 |
| JPEG | 108 |
| Unspecified | 255 |

The attribute streamType can take either a numeric value from 0 to 63 inclusive or a string corresponding to the enumerated values as follows:

| streamType | |
|------------------|---|
| ObjectDescriptor | 1 |
| ClockReference | 2 |
| SceneDescription | 3 |
| Visual | 4 |
| Audio | 5 |
| MPEG7 | 6 |
| IPMP | 7 |
| OCI | 8 |
| MPEGJ | 9 |

The attributes bufferSizeDB, maxBitrate and avgBitrate may directly specify values or allow values to be automatically supplied when set to the value “auto”. In the latter case the XMT-A shall determine appropriate values based on the media for that Elementary stream.

15.8.6 Decoder Specific Info

The decoder specific information constitutes an opaque container with information for a specific media decoder. In most cases the decoder specific info for a media stream can automatically be created as part of the encoding process, or may already exist in the correct format as a header information with the media data or as a separate entity.

In addition to the explicit forms of DecoderSpecificInfo below, for example <BIFSConfig>, the following form is a generic DecoderSpecificInfo element that allows all other decoder specific info descriptors, including custom user private forms, to be encoded.

15.8.6.1 <DecoderSpecificInfo>

```
<DecoderSpecificInfo
  type="auto" | "xml"
  src=""/>
  <param name="" value="">
  <param name="" value="">
  ...
<DecoderSpecificInfo/>
```

15.8.6.1.1 Description

The <DecoderSpecificInfo> element is the XMT-A representation of a generic form of DecoderSpecificInfo as described in subclause 8.6.7.

The attribute type="" allows either the DecoderSpecificInfo to be automatically generated by the XMT-A encoding tool(s) type="auto", or allows values to be given via xml, type="xml", in one of two ways using src="" or param name/value pairs.. Using src="" allows an external source containing information for the DecoderSpecificInfo to be identified. Using a list of name value pairs allows individual values to be given. If both src and name/value pairs are given the name/value pair will override any equivalent value that can be obtained from the src.

In order to allow the specification and easy interchange of binary data, the following two standard name/value pairs are defined:

- name = “hexBytes”, value is a list of hexadecimal byte value, e.g. “56;7A;0;25”
- name = “bytes”, value is a list of mixed decimal and hexadecimal byte values, e.g. “25; 0x56; 7; 0xA”. Where all hexadecimal bytes must be prefixed with 0x.

In general it is expected that type="auto" will most commonly be specified and so no further standardized set of name/value pairs has been defined.

As an example. For a media stream that conveys a Jpeg image the required DecoderSpecificInfo is the JPEGDecoderConfig as described in subclause 8.6.7.1. XMT-A will create the required info when a <DecoderSpecificInfo type="auto"/> element is placed within the <DecoderConfigDescriptor> <decSpecificInfo> element. The objectTypeIndication therein and streamType will guide the XMT-A to generate the correct DecoderSpecificInfo.

15.8.6.2 <BIFSConfig> and <BIFSV2Config>

```
<BIFSConfig
  nodeIDbits="10"
  routeIDbits="10">
  <CommandStream
    pixelMetric="true|false" >
    <size
      pixelWidth="0"
      pixelHeight="0" />
  </CommandStream>
  <AnimationMask
    randomAccess="true|false">
    ...
  </AnimationMask>
</BIFSConfig>
```

```

<BIFSv2Config
  use3DmeshCoding="false|true"
  usePredictiveMFField="false|true"
  nodeIDbits="10"
  routeIDbits="10"
  protoIDbits="10">
  <commandStream
    pixelMetric="true|false" >
    <size
      pixelWidth="0"
      pixelHeight="0" />
  </commandStream>
  <AnimationMask
    randomAccess="true|false">
    ...
  </AnimationMask>
</BIFSv2Config>

```

15.8.6.2.1 Description

The <BIFSConfig> and <BIFSv2Config> elements are the XMT-A representation of the BIFSConfig and BIFSv2Config as described in subclause 9.3.5.2 and 9.3.5.3.

The attributes nodeIDbits, routeIDbits and protoIDbits may either be explicitly coded, in which case the number of bits specified must be used to encode the respective IDs, or any of these attributes may be given the value “auto”. In the case “auto” is specified the XMT-A tool shall determine the number of bits that is sufficient to accommodate the number of IDs required and set the attribute value accordingly.

The <BIFSConfig> and <BIFSv2Config> elements can contain either a <commandStream> or an <AnimationMask>.

The <commandStream> contains the attribute pixelMetric and if the element is present then the binary encoding will have the isCommandStream field bit set to 1. The <size> contains the attributes pixelWidth and pixelHeight and if the element is present then the binary encoding will have the hasSize field bit set to 1.

The <AnimationMask> described a BIFS-Anim stream that animates the scene. The “randomAccess” attribute is false by default.

15.8.6.3 OCI Decoder Configuration

This is the decoder specific info for OCI streams.

```

<DecoderSpecificInfo>
  <param name="versionLabel" value="1" />
</DecoderSpecificInfo>

```

15.8.6.3.1 Description

This is the XMT-A representation of the OCIDecoderConfiguration as described in subclause 8.4.2.4. The name/value pair may be either be explicitly coded as above or the OCI Decoder Configuration will also be created if type=”auto” is specified instead.

15.8.7 <SLConfigDescriptor>

```
<SLConfigDescriptor>
  <predefined value="0">
  <custom
    useAccessUnitStartFlag="true | false"
    useAccessUnitEndFlag="true | false"
    useRandomAccessPointFlag="true | false"
    hasRandomAccessUnitsOnlyFlag="true | false"
    usePaddingFlag="true | false"
    useIdleFlag="true | false"
    timeStampResolution=""
    OCRResolution=""
    timeStampLength=""
    OCRLength=""
    AU_Length=""
    instantBitrateLength=""
    degradationPriorityLength=""
    AU_seqNumLength=""
    packetSeqNumLength="16">
    <duration timescale="0"
      accessUnitDuration="0"
      compositionUnitDuration="0"/>
    <noUseTimeStamps startDecodingTimeStamp="0"
      startCompositionTimeStamp="0"/>
  </custom>
</SLConfigDescriptor>
```

15.8.7.1 Description

The <SLConfigDescriptor> element is the XMT-A representation of the SLConfigDescriptor as described in subclause 10.2.3.

15.8.8 <ContentIdentificationDescriptor>

```
<ContentIdentificationDescriptor
  protectedContent="false">
  <contentType contentType="" />
  <contentIdentifier
    contentIdentifierType=""
    contentIdentifier="" />
</ContentIdentificationDescriptor>
```

15.8.8.1 Description

The <ContentIdentificationDescriptor> element is the XMT-A representation of the ContentIdentificationDescriptor as described in subclause 8.6.10.

The <contentType> contains the attribute contentType and if the element is present then the binary encoding will have the contentTypeFlag field bit set to 1.

The <contentIdentifier> contains the attributes contentIdentifierType and contentIdentifier, and if the element is present then the binary encoding will have the contentIdentifierFlag field bit set to 1.

The attribute contentType can take either a numeric value from 0 to 255 inclusive or a string corresponding to the enumerated values as follows:

| ContentType | |
|--------------------|---|
| Audio-visual | 0 |
| Book | 1 |
| Serial | 2 |
| Text | 3 |
| Item | 4 |
| Contribution | 4 |
| SheetMusic | 5 |
| SoundRecording | 6 |

| | |
|--------------|-----|
| MusicVideo | 6 |
| StillPicture | 7 |
| MusicalWork | 8 |
| Others | 255 |

The attribute contentIdentifierType can take either a numeric value from 0 to 255 inclusive or a string corresponding to the enumerated values as follows:

| contentIdentifierType | |
|------------------------------|----|
| ISAN | 0 |
| ISBN | 1 |
| ISSN | 2 |
| SICI | 3 |
| BICI | 4 |
| ISMN | 5 |
| ISRC | 6 |
| ISWC-T | 7 |
| ISWC-L | 8 |
| SPIFF | 9 |
| DOI | 10 |

15.8.9 <SupplementaryContentIdentificationDescriptor>

```
<SupplementaryContentIdentification
  languageCode=""
  supplContentIdentifierTitle = ""
  supplContentIdentifierValue = ""/>
```

15.8.9.1 Description

The <SupplementaryContentIdentification> element is the XMT-A representation of the SupplementaryContentIdentification as described in subclause 8.6.11.

The languageCode attribute is a three character language code according to specification ISO 639-2:1998.

The supplContentIdentifierTitle attribute is a string (when encoded to binary the required descriptor field supplContentIdentifierTitleLength will be automatically derived from the attribute's string length).

The supplContentIdentifierValue attribute is a string (when encoded to binary the required descriptor field supplContentIdentifierValueLength will be automatically derived from the attribute's string length).

15.8.10 <IPI_DescrPointer>

```
<IPI_DescrPointer IPI_ES_Id="" />
```

15.8.10.1 Description

The <IPI_DescrPointer> element is the XMT-A representation of the IPI_DescrPointer as described in subclause 8.6.12.

The attribute IPI_ES_ID is an IDREF to the ES_ID of the elementary stream whose ES_Descriptor contains the IP Information valid for this elementary stream.

15.8.11 <IPMP_DescriptorPointer>

```
<IPMP_DescriptorPointer IPMP_DescriptorID="" />
```

15.8.11.1 Description

The <IPMP_DescriptorPointer> element is the XMT-A representation of the IPMP_DescriptorPointer as described in subclause 8.6.13.

The attribute IPMP_DescriptorID is an IDREF to the IPMP_Descriptor.

15.8.12 <IPMP_Descriptor>

```
<IPMP_Descriptor
    IPMP_DescriptorID="0"
    binaryID=""
    <IPMPS_URL URLString="" />
    <IPMPS_data type="" IPMP_data="" />
/>
```

15.8.12.1 Description

The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems. The IPMP interface consists of IPMP elementary streams and IPMP descriptors. IPMP descriptors may also be carried as part of an object descriptor stream.

The IPMP System itself is a non-normative component that provides intellectual property management and protection functions for the terminal. The IPMP System uses the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. An application may choose not to use an IPMP System, thereby offering no management and protection features.

The <IPMP_Descriptor> element is the XMT-A representation of the IPMP_Descriptor as described in subclause 8.6.14.

The <IPMPS_URL> element contains the attribute URLString, and if the element is present then the binary encoding will have the IPMPS_Type field set to 0.

The <IPMPS_data> element contains the attributes type and IPMP_data, and if the element is present then the binary encoding will have the IPMPS_Type field set to the value of the type attribute.

15.8.13 <QoS_Descriptor>

```
<QoS_Descriptor>
    <predefined value="1">
        <qualifiers>...</qualifiers>
    </QoS_Descriptor>
```

15.8.13.1 Description

The QoS descriptor conveys the requirements that the elementary stream has on the transport channel and a description of the traffic that this elementary stream will generate.

The <QoS_Descriptor> element is the XMT-A representation of the QoS_Descriptor as described in subclause 8.6.15.

The <predefined> element contains the attribute value, and if the element is present then the binary encoding will have the predefined field set to the value if the value attribute. This value can be from 1 to 255 inclusive.

The <qualifiers> element contains a list of custom QoS Qualifiers if a predefined is not used. If the element is present then the binary encoding will automatically have the predefined field set 0.

15.8.13.2 QoS Qualifiers

```
<QoSMaxDelay      value="0" />
<QoSPrefMaxDelay value="0" />
<QoSLossProb     value="0" />
<QoSMaxGapLoss   value="0" />
<QoSMaxAUSize    value="0" />
<QoSAvgAUSize   value="0" />
<QoSMaxAURate   value="0" />
```

The QoS Qualifier elements above are the XMT-A representations of the QoS_Qualifiers as described in subclause 8.6.15.3

```
<QoSCustom tag="" customData="0"/>
```

The QoS Qualifier elements QoSCustom is the XMT-A representation of a QoS_Qualifier as described in subclause 8.6.15.3 where the tag can be set to values to create user private qualifiers.

```
<QoSRebufferingRatio value="0"/>
```

The QoS Qualifier element above is the XMT-A representations of the QoS_Qualifier REBUFFERING_RATIO as described in clause 5.

15.8.14 <ExtensionDescriptor>

```
<ExtensionDescriptor tag="" customData="" />
```

15.8.14.1 Description

This is a general purpose element to define a custom extension descriptor.

The <ExtensionDescriptor> element is the XMT-A representation of the ExtensionDescriptor as described in subclause 8.6.16.

15.8.15 <RegistrationDescriptor>

```
<RegistrationDescriptor  
formatIdentifier=""  
additionalIdentificationInfo="" />
```

15.8.15.1 Description

The registration descriptor provides a method to uniquely and unambiguously identify formats of private data streams.

The <RegistrationDescriptor> element is the XMT-A representation of the RegistrationDescriptor as described in subclause 8.6.17.

15.8.16 Object Content Information Descriptors

Object content information (OCI) descriptors convey descriptive information about audio-visual objects. The main content descriptors are: content classification descriptors, keyword descriptors, rating descriptors, language descriptors, textual descriptors, and descriptors about the creation of the content. OCI descriptors can be included directly in the related object descriptor or elementary stream descriptor or, if it is time variant, it may be carried in an elementary stream by itself.

15.8.16.1 <ContentClassificationDescriptor>

```
<ContentClassificationDescriptor  
classificationEntity=""  
classificationTable=""  
classificationData="" />
```

15.8.16.1.1 Description

The <ContentClassificationDescriptor> element is the XMT-A representation of the ContentClassificationDescriptor as described in subclause 8.6.18.3

15.8.16.2 <KeyWordDescriptor>

```
<KeyWordDescriptor
  languageCode=""
  isUTF8="true|false"
  <keyWord value="" />
/>
```

15.8.16.2.1 Description

The <KeyWordDescriptor> element is the XMT-A representation of the KeyWordDescriptor as described in subclause 8.6.18.4

The descriptor can contain either 0 to 255 keywords. When the isUTF8 boolean is set true the keywords are coded as UTF8 and the isUTF8_string field in the binary coding is set to 1; otherwise the UTF16 coding is used. For each keyword the keyWordLength field will be binary coded automatically according to the encoded string length. Also the keyWordCount field will be binary coded automatically according to the number of keywords present.

15.8.16.3 <RatingDescriptor>

```
<RatingDescriptor
  ratingEntity=""
  ratingCriteria=""
  ratingInfo="" />
```

15.8.16.3.1 Description

The <RatingDescriptor> element is the XMT-A representation of the RatingDescriptor as described in subclause 8.6.18.5

15.8.16.4 <LanguageDescriptor>

```
<LanguageDescriptor languageCode = "" />
```

15.8.16.4.1 Description

The <LanguageDescriptor> element is the XMT-A representation of the LanguageDescriptor as described in subclause 8.6.18.6

15.8.16.5 <ShortTextualDescriptor>

```
<ShortTextualDescriptor
  languageCode=""
  isUTF8="true|false"
  <event name="" text="" />
/>
```

15.8.16.5.1 Description

The <ShortTextualDescriptor> element is the XMT-A representation of the ShortTextualDescriptor as described in subclause 8.6.18.7

The descriptor contains an event name/text pair. When the isUTF8 boolean is set true eventName (from name attribute) and eventText (from text attribute) are coded as UTF8 and the isUTF8_string field in the binary coding is set to 1; otherwise the UTF16 coding is used. The nameLength and textLength fields will be binary coded automatically according to the encoded string lengths.

15.8.16.6 <ExpandedTextualDescriptor>

```
<ExpandedTextualDescriptor
  languageCode=""
  isUTF8="true|false"
  nonItemText = ""
  <item description="" text="" />
/>
```

15.8.16.6.1 Description

The <ExpandedTextualDescriptor> element is the XMT-A representation of the ExpandedTextualDescriptor as described in subclause 8.6.18.8

The descriptor can contain either 0 to 255 items. When the isUTF8 boolean is set true the UTF8 coding is used and the isUTF8_string field in the binary coding is set to 1; otherwise the UTF16 coding is used. For each itemDescription and itemText the itemDescriptionLength and itemLength fields will be binary coded automatically according to the encoded string lengths. Also the itemCount field will be binary coded automatically according to the number of items present. The nonItemText is also coded according to isUTF8 coding and the nonItemTextLength and textLength fields are binary coded automatically according to the respective content lengths.

15.8.16.7 <ContentCreatorNameDescriptor>

```
<ContentCreatorNameDescriptor>
  <Creator
    languageCode=""
    isUTF8="true|false"
    name="" />
</ContentCreatorNameDescriptor>
```

15.8.16.7.1 Description

The <ContentCreatorNameDescriptor> element is the XMT-A representation of the ContentCreatorNameDescriptor as described in subclause 8.6.18.9

The descriptor can contain either 0 to 255 Creator elements. When the isUTF8 boolean is set true the name, in the contentCreatorName field, is coded as UTF8 and the isUTF8_string field in the binary coding is set to 1; otherwise the UTF16 coding is used. For each name the contentCreatorLength field will be binary coded automatically according to the encoded string length. Also the contentCreatorCount field will be binary coded automatically according to the number of creators present.

15.8.16.8 <ContentCreationDateDescriptor>

```
<ContentCreationDateDescriptor contentCreationDate="" />
```

15.8.16.8.1 Description

The <ContentCreatorNameDescriptor> element is the XMT-A representation of the ContentCreatorNameDescriptor as described in subclause 8.6.18.10

15.8.16.9 <OCICreatorNameDescriptor>

```
<OCICreatorNameDescriptor>
  <Creator
    languageCode=""
    isUTF8="true|false"
    name="" />
</OCICreatorNameDescriptor>
```

15.8.16.9.1 Description

The <OCICreatorNameDescriptor> element is the XMT-A representation of the OCICreatorNameDescriptor as described in subclause 8.6.18.11

The descriptor can contain either 0 to 255 Creator elements. When the isUTF8 boolean is set true the name, in the OCICreatorName field, is coded as UTF8 and the isUTF8_string field in the binary coding is set to 1; otherwise the UTF16 coding is used. For each name the OCICreatorLength field will be binary coded automatically according to the encoded string length. Also the OCICreatorCount field will be binary coded automatically according to the number of creators present.

15.8.16.10 <OCICreationDateDescriptor>

```
<OCICreationDateDescriptor OCICreationDate="" />
```

15.8.16.10.1 Description

The <OCICreationDateDescriptor> element is the XMT-A representation of the OCICreationDateDescriptor as described in subclause 8.6.18.12

15.8.16.11 <SMPTECameraPositionDescriptor>

```
<SMPTECameraPositionDescriptor
  cameraID=""
  <parameter id="" value="" />
/>
```

15.8.16.11.1 Description

The <SMPTECameraPositionDescriptor> element is the XMT-A representation of the SMPTECameraPositionDescriptor as described in subclause 8.6.18.13

The descriptor can contain either 0 to 255 parameter elements. For each parameter an id (parameterID field) and parameter value (parameter field) will be binary coded automatically from the attributes. The parameterCount field will be binary coded automatically according to the number of parameters present.

15.8.17 <ExtensionProfileLevelDescriptor>

```
<ExtensionProfileLevelDescriptor
  profileLevelIndicationIndex=""
  ODProfileLevelIndication=""
  sceneProfileLevelIndication=""
  audioProfileLevelIndication=""
  visualProfileLevelIndication=""
  graphicsProfileLevelIndication=""
  MPEGJProfileLevelIndication="" />
```

15.8.17.1 Description

The <ExtensionProfileLevelDescriptor> element is the XMT-A representation of the ExtensionProfileLevelDescriptor as described in subclause 8.6.19

For the attributes ODProfileLevelIndication, sceneProfileLevelIndication, audioProfileLevelIndication, visualProfileLevelIndication and graphicsProfileLevelIndication see 15.8.2.1.

The attribute MPEGJProfileLevelIndication takes either a numeric value from 0 to 255 inclusive or a string corresponding to the enumerated values as follows:

| MPEGJProfileLevelIndication | |
|------------------------------------|-----|
| Personal L1 | 1 |
| Main L1 | 2 |
| Unspecified | 254 |
| None | 255 |

15.8.18 <SegmentDescriptor>

```
<SegmentDescriptor start=""
  duration=""
  segmentName=""
/>
```

15.8.19 Object Descriptor Commands

The following describes the object descriptor commands:

15.8.19.1 <ObjectDescriptorUpdate>

```
<ObjectDescriptorUpdate atES_ID="">
  <OD>...</OD>
</ObjectDescriptorUpdate>
```

15.8.19.1.1 Description

The <ObjectDescriptorUpdate> element is the XMT-A representation of the ObjectDescriptorUpdate as described in subclause 8.5.5.2.

15.8.19.2 <ObjectDescriptorRemove>

```
<ObjectDescriptorRemove objectDescriptorId="" />
```

15.8.19.2.1 Description

The <ObjectDescriptorRemove> element is the XMT-A representation of the ObjectDescriptorRemove as described in subclause 8.5.5.3.

15.8.19.3 <ObjectDescriptorExecute>

```
<ObjectDescriptorExecute objectDescriptorId="" />
```

15.8.19.3.1 Description

The <ObjectDescriptorExecute> element is the XMT-A representation of the ES_DescriptorUpdate as described in subclause 8.5.5.8.

15.8.19.4 <ES_DescriptorUpdate>

```
<ES_DescriptorUpdate atES_ID="" objectDescriptorId="">
  <esDescr>...</esDecsr>
</ES_DescriptorUpdate>
```

15.8.19.4.1 Description

The <ES_DescriptorUpdate> element is the XMT-A representation of the ES_DescriptorUpdate as described in subclause 8.5.5.4.

15.8.19.5 <ES_DescriptorRemove>

```
<ES_DescriptorRemove atES_ID="" objectDescriptorId="" />
```

15.8.19.5.1 Description

The <ES_DescriptorRemove> element is the XMT-A representation of the ES_DescriptorRemove as described in subclause 8.5.5.5.

15.8.19.6 <IPMP_DescriptorUpdate>

```
<IPMP_DescriptorUpdate atES_ID="">
  <ipmpDescr>...</ipmpDecsr>
</IPMP_DescriptorUpdate>
```

15.8.19.6.1 Description

The <IPMP_DescriptorUpdate> element is the XMT-A representation of the IPMP_DescriptorUpdate as described in subclause 8.5.5.6.

15.8.19.7 <IPMP_DescriptorRemove>

```
<IPMP_DescriptorRemove atES_ID="" IPMP_DescriptorID="" />
```

15.8.19.7.1 Description

The <IPMP_DescriptorRemove> element is the XMT-A representation of the IPMP_DescriptorRemove as described in subclause 8.5.5.7.

15.9 XMT-A IPMP Streams

An IPMP stream is an elementary stream that passes time-varying information to one or more IPMP Systems. This is accomplished by periodically sending a sequence of IPMP messages along with the content at a period determined by the IPMP system.

```
<IPMP_Message atES_ID="">
  <IPMPS_URL URLString="" />
  <IPMPS_data type="" IPMP_data="" />
</IPMP_Message>
```

15.9.1 Description

The <IPMP_Message> element is the XMT-A representation of the IPMP_Message as described in subclause 8.3.2.5.

15.10 XMT-A OCI Streams

An OCI stream is an elementary stream that conveys time-varying object content information organized in a sequence of small, synchronized entities called OCI events that contain a set of OCI descriptors.

```
<OCI_Event atES_ID=""
  eventID=""
  absoluteTimeFlag="true|false"
  startingTime=""
  duration="">
  <OCIDescr>...</OCIDescr>
</OCI_Event>
```

15.10.1 Description

The <OCI_Event> element is the XMT-A representation of the OCI_Event as described in subclause 8.4.2.5.

15.11 XMT-A MPEG-J Streams

An MPEG-J stream is an elementary stream that conveys the Java class files for and MPEG-4 MPEGlet. The source attribute references an external class, object, packaged file or other resource that comprises an MPEGlet or resources that can be loaded by the MPEGlet.

```
<JavaStreamHeader atES_ID=""
  url=""
  version="0"
  isClassFlag="true|false"
  isPackaged="true|false"
  compressionScheme=""
  <classID ID="">
    <reqClassID><classID ID="">...</reqClassID>
  </JavaStreamHeader>
```

15.11.1 Description

The <JavaStreamHeader> element is the XMT-A representation of the JavaStreamHeader as described in subclause 11.4.3.2.

The url attribute is a uriReference to a class or ZIP package etc that form the body of the access unit that the JavaStreamHeader prefaces. When the XMT-A encoder creates the access unit it will do so from the binary encoding of the stream header followed by the content of the url.

15.12 XMT-A Elementary Stream Data

Visual, audio, and MPEG-7 elementary stream data are referenced and associated with the Elementary Stream Descriptors using the <StreamSource> element. The <StreamSource> element is contained within the Elementary Stream Descriptor element.

Some elementary streams, such as BIFS and OD have textual representations with XMT-A that is used to create the streams via an encoding process. Other media sources, such as video and audio, have no textual representation of the media itself. However a variety of video or audio sources etc can be referenced and these sources do not necessarily have to be in the final target format for the stream. Conversion (transcoding or encoding) from source to target formats may be supported by the XMT-A authoring tool; basic support requires only that a tool can handle media in the correct target format. Transcoding and encoding externally referenced media etc is optional and may be authoring tool and platform dependent.

For elementary streams that are represented textually within the XMT-A document a <StreamSource> may still be used within the <ESDescriptor> to supply <EncodingHints>, for example for BIFS. For this case the url attribute would be omitted.

15.12.1 <StreamSource>

```
<StreamSource
  url=""
  <EncodingHints>...</EncodingHints>
</StreamSource>
```

url refers to the external source for the media data. Whether it be pre-encoded or requires encoding. The <EncodingHints> allow the source and/or target formats to be described so that when encoding is required the author can control various parameters of the encoding process where supported by the encoder.

<EncodingHints> cannot override any explicit values provided in <DecoderConfigDescriptor> including those in any <DecoderSpecificInfo> specified therein. An encoder shall ensure that the encoded stream source complies with the objectTypeIndication, streamType, bufferSizeDB etc. Some parameters however may be set to "auto", eg bufferSizeDB, maxBitrate etc. The values used for these auto fields, when the descriptors are binary coded, will then be based on the results of the encoding process according to the <EncodingHints>. The entire <DecoderSpecificInfo> may also be automatically coded when specified using type="auto". Using auto allows XMT-A to encode any generate the necessary decoder configuration parameters without the author needing to explicitly provide these values.

15.12.2 Object Descriptor Streams

Object Descriptor commands are coded as timed elements and associated to a particular Elementary Stream Descriptor using the atES_ID attribute in the various commands.

By default atES_ID will take on the value of the ID of the first Elementary Stream Descriptor, in document order, contained in the Initial Object Descriptor that contains a DecoderConfigDescriptor of stream type ObjectDescriptorStream. Hence for MPEG-4 content with a single ODStream the atES_ID will default as expected and minimize explicit coding. Any additional ODStreams would require the commands to be explicitly coded for respective atES_ID to which the command should be associated.

15.12.3 Clock Reference Streams

No <StreamSource> is required. A Clock Reference stream is defined using the SLConfigDescriptor in the ElementaryStreamDescriptor that contains a DecoderConfigDescriptor of stream type CleockReferenceStream.

15.12.4 Scene Description Streams

BIFS commands are coded as timed elements and associated to a particular Elementary Stream Descriptor using the atES_ID attribute in the various commands .

By default atES_ID will take on the value of the ID of the first Elementary Stream Descriptor, in document order, contained in the Initial Object Descriptor that contains a DecoderConfigDescriptor of stream type SceneDescriptionStream. Hence for MPEG-4 content with a single BIFS Stream the atES_ID will default as expected and minimize explicit coding. Any additional BIFS Streams, e.g. if there were a scaleable BIFS representation, would require the commands to be explicitly coded for the respective atES_ID to which the command should be associated.

15.12.5 IPMP Streams

<StreamSource> will refer to IPMP media data and an Elementary Stream Descriptor of type IPMPStream.

Alternatively IPMP message can be coded as timed elements and associated to a particular Elementary Stream Descriptor using the atES_ID attribute in the <IPMPMessage>.

15.12.6 Visual Streams

<StreamSource> will refer to a visual media and an Elementary Stream Descriptor that contains a DecoderConfigDescriptor of stream type VisualStream.

15.12.7 Audio Streams

<StreamSource> will refer to an audio media and an Elementary Stream Descriptor that contains a DecoderConfigDescriptor of stream type AudioStream.

15.12.8 MPEG-7 Streams

<StreamSource> will refer to MPEG-7 media data and an Elementary Stream Descriptor that contains a DecoderConfigDescriptor of stream type MPEG7Stream.

15.12.9 IPMP Streams

IPMP messages are coded as timed elements and associated to a particular Elementary Stream Descriptor, that contains a DecoderConfigDescriptor of stream type IPMPStream, using the atES_ID attribute in the <IPMPMessage>.

15.12.10 OCI Streams

OCI events are coded as timed elements and associated to a particular Elementary Stream Descriptor, that contains a DecoderConfigDescriptor of stream type ObjectContentInfoStream, using the atES_ID attribute in the <OCIEvent>.

15.12.11 MPEG-J Streams

MPEG-J streams are coded as timed elements, using the <JavaStreamHeader> element, and associated to a particular Elementary Stream Descriptor, that contains a DecoderConfigDescriptor of stream type MPEGJStream, using the atES_ID attribute in the <JavaStreamHeader>.

15.13 XMT-A Deterministic mapping

In encoding XMT-A into binary some features may be encoded differently producing alternate binary representations that are all legally valid. In part to allow the author control where needed over mapping, and in part to allow a deterministic mapping for conformance the following ‘devices’ allow us to achieve this.

1. Elements are to be maintained in document order, unless they are elements timed by a <par> element in which case they should be sorted into temporal order while maintaining the document order of any elements occurring at the same time. For independently coded streams this temporal sorting can be done on a per stream basis.
2. Following the sorting in step 1 any elements now are to be encoded in temporal order with any nested complex elements occurring at any given time to be encoded strictly in the order that they appear in the XMT document being converted to mp4. This is to ensure:
 - a. Elements to be coded at the same time in a single AU will thus be in the same order.
 - b. Multiple commands, or updates of fields will hence be in the same order.
 - c. Scene elements will then be in the same order under groups.
3. For attributes we cannot expect an XML parser to maintain the list of attributes in document order. So for this case, where it is needed, there are encoding hints on how to map attributes. For example, in BIFS this is needed as there are options for list or vector codings etc; whereas for the OD framework the fields are coded in a predetermined order as so it is not required. However, multi-value single attributes must preserve the order of the multiple values in the coding.

4. Elements are identified in the XMT by an id (a name). The name is convenient for the XMT as references can be made back to a human readable, meaningful name. These ids must often be coded into NodeIDs or ObjectDescriptor IDs etc. Normally the XMT authoring tool can create binary numeric IDs for all the names and ensure their uniqueness. To ensure a given conversion to a specific binary value the binaryID attribute has been added to elements whose names must be converted to binary. The authoring tool must respect the binary conversion wherever it is so explicitly given.
5. Some elements such as BIFS <Insert> can insert field values defined by attributes plus it can contain <ROUTE> commands to insert routes. For any elements such as these the command(s) contained in the attributes must be coded before any child elements.
6. Multiple commands, specified by a multi-value single attribute must be coded in the order that the multiple values occur.
7. Conditional SFCommandBuffer fields shall be coded using smallest possible number of padding bits (no extra bytes at the end). Also the length field shall be specified using the smallest number of bits that can accommodate the length, i.e minimize lengthBits.

15.14 XMT-A Animation

15.14.1 Overview

BIFS-Anim is a binary format used in MPEG-4 systems to transmit animation of objects in a scene. Each animated node is referred by its DEF identifier and one or many of its fields may be animated. BIFS-Anim is a key frame technique that specifies the value of each animated field frame by frame, at a defined frame rate. For better compression, each field value is quantized and adaptively arithmetic encoded.

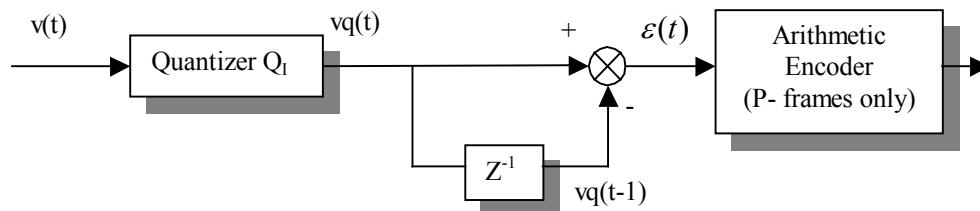


Figure 1 – BIFS Anim encoding process. Z^{-1} stands for one frame delay. The value $v(t)$ at frame t is quantized with Quantizer Q , and the difference $\varepsilon(t)$ with the previous quantized value $vq(t-1)$ at frame $t-1$ is adaptively arithmetic encoded.

Two kinds of frames are available: Intra and Predictive frames. I-frames contain raw quantized field values $vq(t)$, and P-frames contain arithmetically encoded difference field values $\varepsilon(t) = vq(t) - vq(t-1)$.

A BIFS-Anim frame can animate values by in different nodes nodes, i.e. each frame will specify the nodes that it animates, and will then animate all the fields of the specified nodes. As BIFS-Anim is a key-frame based system, a frame can be only I or P, consequently all field values in an animated node must be I or P coded, and each field of a given node is animated at the same frame rate.

This textual format is designed to allow authors to specify what can be encoded in a bitstream. It is allows specification of every encoding hint possible in BIFS-Anim.

There are two top level elements used in BIFS-Anim. The first is <AnimationMask>, which appears inside a <BIFSConfig> element and contains initializing information. The second is an <AnimationFrame> element, which must appear inside of a <par> element and holds the animation frame data.

15.14.2 <AnimationMask>

```

<AnimationMask
  randomAccess = "true|false">
  <ElementaryMask id="">
  </ElementaryMask>
  ...
  
```

```
<ElementaryMask ....> ... </ElementaryMask>
</AnimationMask>
```

15.14.2.1 Description

The `<AnimationMask>` element is the XMT-A representation of the AnimationMask as described in subclause 9.3.5.4.

The randomAccess attribute is described in the BIFSConfig and BIFSV2Config as described in subclauses 9.3.5.2 and 9.3.5.3.

The `<AnimationMask>` tag holds a collection of one or more `<ElementaryMask>` tags.

15.14.3 `<ElementaryMask>`

```
<ElementaryMask atNode="">
    <InitialFieldsMask> ... </InitialFieldsMask>
    <InitialFieldsMask> ... </InitialFieldsMask>
    ...
    <InitialFieldsMask> ... </InitialFieldsMask>
</ElementaryMask>
```

15.14.3.1 Description

The `<ElementaryMask>` element is the XMT-A representation of the ElementaryMask as described in subclause 9.3.5.5.

The `<ElementaryMask>` tag holds a collection of `<InitialFieldsMask>` tags.

The `atNode` attribute holds the ID of the animated node.

15.14.4 `<InitialFieldsMask>`

```
<InitialFieldsMask
    id=""
    isTotal="true|false"
    indexList = "..."                                // optional
    >
    <InitialAnimQP .. />
</InitialFieldsMask>
```

15.14.4.1 Description

The `<InitialFieldsMask>` element is the XMT-A representation of the InitialFieldsMask as described in subclause 9.3.5.6.

An `<InitialFieldsMask>` element shall contain exactly one `<InitialAnimQP>` tag.

The `id` attribute shall hold the name of the field to be animated. The attributes `isTotal` and `indexList` concern only MFFields. The `isTotal` attribute shall be false by default. If `isTotal` is set to true, the `indexList` attribute shall be ignored. The `indexList` attribute holds a list of index value.

15.14.5 `<initialAnimQP>`

```
<InitialAnimQP
    type = "1..13"
    useDefault = "true|false"                           // optional
    >
```

```

useLowerBoundEfficientCoding = "..." // optional
useUpperBoundEfficientCoding = "..." // optional
lowerBound = "..."
upperBound = "..."
IminInt = "..." // optional, used only for type=13
InbBits = "..."
Pmin = "..."
PnbBits = "..." />

```

15.14.5.1 <Description>

The <InitialAnimQP> element is the XMT-A representation of the InitialAnimQP as described in subclause 9.3.5.7.

The userLowerBoundEfficientCoding and userUpperBoundEfficientCoding are a comma, separated array of Boolean values with length that's equal to the getNbBounds() for the animated field. The default values for these fields is false.

An example of its use :

```

<AnimationMask>
  <ElementaryMask id = "COLOR0">
    <InitialFieldsMask id="color"
      indexList = "1 3 10"> <!--this MFField has more than 10 values-->
      <InitialAnimQP
        type = "4"
        lowerBound = "0 0 0"
        upperBound = "1 1 1"
        useUpperBoundEfficientFloat = "true true true"
        useLowerBoundEfficientFloat = "true true true"
        InbBits = "8"
        PnbBits = "9"
        Pmin = "-256 -256 -256"/>
    </InitialFieldsMask>
  </ElementaryMask>
  <ElementaryMask id = "TX1"> <!-- a transform node -->
    <InitialFieldsMask id = "translation"> <!-- an SFVec3f -->
      <InitialAnimQP
        type = "1"
        lowerBound = "-10.0 -10.0 -10.0"
        upperBound = "10.0 5.0 5.0"
        useUpperBoundEfficientFloat = "true true true"
        useLowerBoundEfficientFloat = "true true true"
        InbBits = "8"
        PnbBits = "9"
        Pmin = "-256 -256 -256"/>
    </InitialFieldsMask>
  </ElementaryMask>
</AnimationMask>

```

15.14.6 <AnimationFrame>

```

<AnimationFrame atES_ID=""
  animationStartCode = "" // optional
  isIntra = "true|false"

  TimeCode = "" // optional
  SkipFrames = "" // optional

```

```

>
<FrameRate .. />                                // optional
<AnimationFrameData> .. </AnimationFrameData>
...
<AnimationFrameData> .. </AnimationFrameData>
</AnimationFrame>

```

15.14.6.1 Description

The `<AnimationFrame>` element is the XMT-A representation of the AnimationFrame as described in subclause 9.3.8.2. It also contains the data skipFrames from subclause 9.3.8.5.

The skipFrames attribute holds an integer specifying the number of frames to skip.

The `<AnimationFrame>` element holds a collection of zero or more `<AnimationFrameData>` elements.

The atES_ID attribute indicates the destination of the AnimationFrame. It specifies a symbol which is the ID of the elementary stream into which the AnimationFrame should be encoded. In the case of conflicting atES_ID values in parent par elements, this attribute takes precedence.

15.14.7 <FrameRate>

```

<FrameRate
    frameRate = "[0..255]"
    seconds   = "[0..15]"

    frequencyOffset  = "[0..1]"
/>

```

15.14.7.1 Description

The `<FrameRate>` element is the XMT-A representation of the FrameRate as described in subclause 9.3.8.4.

15.14.8 <AnimationFrameData>

```

<AnimationFrameData
    maskID = ""           // optional in place of id
    atNode = "">          // optional in place of maskID
    <AnimationField> ... </AnimationField>
    ...
    <AnimationField> ... </AnimationField>
</AnimationFrameData>

```

15.14.8.1 Description

The `<AnimationFrameData>` element is the XMT-A representation of the functionality of the AnimationFrameData as described in subclause 9.3.8.6. However, in XMT-A, each `<AnimationFrameData>` describes data for just one animated node, where as in subclause 9.3.8.6, a mechanism is described to specify all the animated nodes at once.

An `<AnimationFrameData>` defines a node which is to be animated within a particular `<AnimationFrame>`.

The maskID or atNode attributes can optionally be used to specify animated node, but one must be specified. The nodes defined in the `<ElementaryMask>` element shall be referenced in masked using their order (starting with index 1). The animated nodes may alternatively be referenced using their DEF name.

The `<AnimationFrameData>` contains a sequence of zero or more `<AnimationField>` elements.

15.14.9 <AnimationField>

```
<AnimationField
    maskID = ""          // optional in place of id
    id = ""              // optional in place of maskID
    values = "">
    <animQP .../>      // optional
</ AnimationField>
```

15.14.9.1 Description

The <AnimationField> element is the XMT-A representation of the functionality of the AnimationField as described in subclause 9.3.8.7.

Inside an <AnimationFrameData>, all the fields specified in the <InitialFieldsMask> will be animated. For fields that don't need to be animated at the time of the current <AnimationFrame>, the previous value will have to be encoded. Thus all the animated fields don't have to be specified, but the missing ones will be encoded with their previous values.

The *id* attribute is the name of the animated field. As the case for <AnimationFrameData>, fields may be identified in the *maskID* attribute using their order (starting with index 1) in the list of animated field of the current node.

An optional <animQP> element can be specified, but only for animationFrames set as Intra Frames.

Example:

```
<par begin="10.0s">
    <animationFrame isIntra = "true">
        <AnimationFrameData id = "TX1">
            <AnimationField maskID = "1" values = " 1.0 2.0 3.3"> # SFVec3f
            <animQP .../>
        </ AnimationField>
    </AnimationFrameData>
    </animationFrame>
</par>
<par begin="10.5s">
    <animationFrame isIntra = "false">
        <AnimationFrameData maskID = "1"> # this is node COLOR0
            <AnimationField
                maskID = "1"
                values = " 1.0 1.0 0.9  0.5 0.5 0.5  0.0 0.0 1.0"> # MFColor
        </ AnimationField>
    </AnimationFrameData>
    <AnimationFrameData maskID="2"> # this is node TX1
        <AnimationField
            maskID = "1"
            values = "1.1 2.1 3.4">
        </ AnimationField>
    </AnimationFrameData>
</animationFrame>
</par>
```

At time 10.0, only one of the nodes will be animated, but two nodes will be animated at time 10.5.

At time 10.5 we animate an MFField with 3 animated Indices. All the values of the animated indices are required.

15.14.10 <AnimQP>

```

<AnimQP
    type = "1..13"
    useDefault = "true|false"                                // optional
    useLowerBoundEfficientCoding = "true|false"             // optional
    useUpperBoundEfficientCoding = "true|false"             // optional
    lowerBound = ""
    upperBound = ""
    IminInt = ""
    InbBits = ""
    Pmin = ""
    optional
    PnbBits = ""                                         // optional
/>

```

15.14.10.1 Description

The <AnimQP> element is the XMT-A representation of the functionality of the AnimQP as described in subclause 9.3.8.8.

15.14.10.2 FBA Animation

Face and Body animation parameters shall be placed in separate XML files. These files shall be referenced in the relevant ES_Descriptors with StreamSource elements.

15.15 Predictive MF Coding

The XMT-A <Predictive> element allows representation of advanced coding of multiple value fields.

15.15.1 <Predictive>

```

<Predictive>
    <PredictiveMFField name="">...</PredictiveMFField >
    <PredictiveMFField name="">...</PredictiveMFField>
    ...
</Predictive>

```

15.15.1.1 Description

The <Predictive> element is a container for the <PredictiveMFField> element, which can appear once for each numerical MFField in the node.

15.15.2 <PredictiveMFField>

```

<PredictiveMFField name="">
    <ArrayHeader>...</ArrayHeader>
    <ArrayOfValues>...</ArrayOfValues>
</PredictiveMFField >

```

15.15.2.1 Description

The <PredictiveMFField> element is the XMT-A representation of the PredictiveMFField as described in subclause 9.3.7.10. The name attribute specifies the name of the field whose values are represented. The <ArrayHeader>, and <ArrayOfValues> elements are described below.

15.15.3 <ArrayHeader>

```
<ArrayHeader NbBits = "0..31" IntraMode = "0..2">
  <InitialArrayQP/>
</ArrayHeader>
```

15.15.3.1 Description

The <ArrayHeader> element is the XMT-A representation of the ArrayHeader as described in subclause 9.3.7.11. There is no need to specify a numberOfFields values as in the binary sequence, since it can be deduced from the field values. It contains an <InitialArrayQP> which holds the initial quantization parameters for the encoding.

15.15.4 <InitialArrayQP>

```
<InitialArrayQP
  NbBits = "0..31" intraInterval=""          // coded only if IntraMode==1
  CompNbBits = "0..31"
  vq= "" Pmin="" />                      // arrays of length getNbComp()
```

15.15.4.1 Description

The <InitialArrayQP> element is the XMT-A representation of the InitialArrayQP as described in subclause 9.3.7.12. The NbBits and intraInterval values shall appear only when the IntraMode of the enclosing <ArrayHeader> has value 1. The vq and Pmin values hold arrays of length getNbComp(), which is the number of components for the field that is being encoded.

15.15.5 <ArrayOfValues>

```
<ArrayOfValues IPPolicy = "" arrayQPFlag="">
  <ArrayQP/>                                // optional ArrayQPs
  <ArrayQP/> . . .
  <ArrayQP/>
<ArrayOfValues/>
```

15.15.5.1 Description

The <ArrayOfValues> element is the XMT-A representation of some of the functionality in ArrayOfValues, as described in subclause 9.3.7.14. However, in XMT-A, the field values are not stored in this element; they are stored in the field element just as if predictive coding were not used. The <ArrayOfValues> element is used to specify Intra and Predictive frames when the IntraMode of the <ArrayHeader> has value 2. This element is also used to specify when new Quantization parameters are sent in the stream using an <ArrayQP>

The IPPolicy attribute holds an integer array with values corresponding to the indices of the Intra frames in the stream. The arrayQPFlag is a numerical array with length equal to the number of Intra frames in the encoding. It specifies which Intra frames carry new quantization parameters. Note that the number of Intraframes can be dependent on the value of IPPolicy (when IntraMode is 2), or it may depend on the intraInterval in the <InitialArrayQP>, when the IntraMode is 1. If IntraMode is 0, both the IPPolicy and arrayQPFlag attributes shall be ignored.

For each value of arrayQPFlag that is 1, there shall be a corresponding <ArrayQP> element that conveys a new set of quantization parameters for the encoding.

15.15.6 <ArrayQP>

```
<ArrayQP
  NbBits = "0..31" intraInterval=""          // coded only if IntraMode==1
  CompNbBits = "0..31"
  vq= "" Pmin="" />                      // optional arrays
```

15.15.6.1 Description

The <ArrayQP> element is the XMT-A representation of the ArrayQP as described in subclause 9.3.7.13. The NbBits and intralInterval values shall appear only when the IntraMode of the enclosing <ArrayHeader> has value 1. The vq and Pmin values are optional arrays that hold arrays of length getNbComp(), which is the number of components for the field that is being encoded. The difference between the <ArrayQP> and <InitialArrayQP> is that the latter requires specification of CompNbBits, vq, and Pmin.

Example :

```
<ScalarInterpolator
    key="0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0"
    keyValue="0 0.12 0.23 0.34 0.45 0.56 0.67 0.78 0.89 0.90 1.00">
<Predictive>
    <PredictiveMFField name="key">
        <ArrayHeader NbBits=4 IntraMode=0>
            <InitialArrayQP CompNbBits=10 vq="0" Pmin="0">
        </ArrayHeader>
    </PredictiveMFField>
    <PredictiveMFField name="keyValue">
        <ArrayHeader NbBits=4 IntraMode=2>
            <InitialArrayQP CompNbBits=10 vq="0" Pmin="0">
        </ArrayHeader>
        <ArrayOfValues IPPolicy="0 4 10" arrayQPFlag="1,0">
            <ArrayQP CompNbBits=14>
        </ArrayOfValues>
    </PredictiveMFField>
</Predictive>
</ScalarInterpolator>
```

16 XMT-Ω Format

The goal of the XMT-Ω format is to provide ease of use, facilitate content interchange and to be interoperable with the Synchronized Multimedia Integration Language (SMIL) 2.0, for which the specification was developed by the W3C SYMM WG.

The XMT-Ω format describes audio-visual objects and their relationships at a higher level than XMT-A. Here content requirements are expressed in terms of an author's intent rather than by coding explicit node and route connections. This permits an authoring tool to offer constructs at this higher level and to exchange them at this level with other authoring tools. An authoring tool would compile the XMT-Ω format into MPEG-4 content by mapping the constructs into BIFS, OD, media streams, etc. together with any appropriate media compression and/or media conversions that may be required. Media sources expressed in XMT-Ω can be of a variety of formats native to the machine where the authoring tool is executing, and it is the responsibility of the tool, during the compilation phase, to convert the media to suitable formats, bit-rates, and so on.

In this high-level format, there is not necessarily only one mapping to MPEG-4 for each construct. MPEG-4 nodes and routes are very powerful tools and there can be more than one way to represent XMT-Ω constructs. Also, as MPEG-4 nodes can be 'wired' together with routes in many combinations, it is often difficult to reverse-engineer an author's intent from a collection nodes and routes. Faced with a presentation containing many nodes and routes, the re-authoring and maintenance of content can be challenging as the high-level view of that presentation must be inferred. The XMT-Ω, however, provides such a high-level view with high-level authoring constructs and thus facilitates content exchange, rapid content re-purposing or re-authoring and maintenance of content.

Recognizing though that some authors may wish to access low-level nodes/routes, this format allows the embedding of the XMT-A textual node and route definitions within an identified low-level nodes section. Interoperation between the two levels are also permitted.

16.1 XMT-Ω re-using SMIL

To capture content authors intentions at a high-level, the SMIL (Synchronized Multimedia Integration Language) is used as a basis for the abstraction of the XMT-Ω content representation. The version of SMIL upon which XMT-Ω is based on the SMIL 2.0 specification, (the follow-on to SMIL 1.0), that was developed by the W3C SYMM working

group. For brevity, rather than constantly refer to SMIL 2.0 any references will be made simply as "SMIL" in the remainder of this document where there is no ambiguity.

SMIL is an XML-based language that allows authors to write interactive multimedia presentations. The main strengths of SMIL are that its constructs are self-describing, it is based on XML which provides an excellent format for interchange of data among different applications, it is relatively easy to author, and it is a language familiar to HTML users. It is also extensible so that new objects or metadata can easily be inserted in the representation.

The XMT-Ω format provides a new set of elements that expresses the high-level view of MPEG-4, while re-using a subset of modules defined by SMIL where the semantics are compatible. XMT-Ω is not specifically designed as a playback format, and is intended to be preprocessed to SMIL, WEB3D (VRML), or compiled to an MPEG-4 representation via appropriate translation software.

16.1.1 Re-using SMIL Modules

The SMIL language is composed of a number of functional areas that have broken down into a finer granularity using modules. These modules, comprising XML element and attributes, and attribute values, can then be combined and brought together in other host languages such as XMT-Ω. XMT-Ω is referred to as a host language since it integrates, or hosts, the modules within a larger set of XML representation.

SMIL provides guidelines and requirements for integration of the modules it defines into a host language. XMT-Ω, unless explicitly stated otherwise, will follow these guidelines and requirements and adhere to the semantics of the modules as well as their syntax. SMIL is a language that has been designed and then implementations follow. XMT-Ω, however, already has MPEG-4 as a implementation and is using this language to represent it, albeit at a high-level. Hence XMT-Ω must be mapped (compiled) into MPEG-4 and certain behaviors specified by SMIL may be difficult, or overly complicated, to maintain the semantics for all cases. This document will highlight such areas as necessary. In all cases it is the authoring tools responsibility to maintain correct semantics during the mapping. All the power of the MPEG-4 representation, including Scripts and MPEG-J, may be used by the authoring tool to achieve satisfactory mappings. An authoring tool will of course limit the use of MPEG-4 tools to those supported by the MPEG-4 profile and level for which the presentation is being created. Mapping for the semantics are both static and dynamic in nature. Static mappings capture the semantics for deterministic behavior that can be fully evaluated during the mapping. Dynamic mappings require runtime support of MPEG-4 player mechanisms and, for example, may be utilized to support non-deterministic behavior such as is involved in unpredictable user interactions.

Subsequent sections of this document will cover XMT-Ω and its use of SMIL modules in more detail. The following is a brief overview of the functional areas of SMIL and their re-use in XMT-Ω :

- Animation.

XMT-Ω will incorporate the SMIL Animation modules. These modules support dynamic updating, i.e. animation of attributes. SMIL semantics require the authored value as well as the animated value of an attribute to be available. MPEG-4 routes overwrite fields making such semantics the authoring tools responsibility to maintain.

- Content Control.

Allows content choice and selection based on test attributes. May be mapped to MPEG-4 constructs such as alternate streams, for example selection based on language. Also may be used to select alternate content at compile time.

- Layout

XMT-Ω will not incorporate SMIL Layout modules. Layout will however be defined that is consistent with the hierarchical tree structured spatial layout and groupings intrinsic to MPEG-4.

- Linking.

XMT-Ω will not incorporate SMIL Linking modules. However support for linking that can be mapped to the Anchor node will be defined.

- Media

XMT-Ω incorporates SMIL media modules plus it extends this set to include MPEG-4 specific media.

- Metainformation

XMT-Ω incorporates SMIL metainformation modules. In addition XMT-Ω supports MPEG-7 meta representations.

- Timing and Synchronization

SMIL contains extensive, comprehensive timing modules. XMT-Ω incorporates most of these modules.

- Time Manipulations

XMT-Ω incorporates SMIL Time Manipulations module which permits time transformations.

- Transitions

SMIL supports high-level transitions with effects defined by SMPTE as well as effects defined by SMIL. XMT-Ω incorporates some of these transition modules.

16.2 XMT-Ω Animation

SMIL Animation feature comprises two modules; BasicAnimation and SplineAnimation. XMT-Ω will include the features of both modules.

All the XMT-Ω Timing and Synchronization module attributes are supported to control the timelines of the elements of these Animation modules. As XMT-Ω incorporates the BasicTimeContainer module from Timing and Synchronization the fill attribute is also supported on all Animation elements.

Attributes of xMedia elements and their child elements, attribute of Media Augmentation elements, and attributes of the Media Group may all be animated.

16.2.1 BasicAnimation

BasicAnimation includes the <animate>, <set>, <animateMotion> and <animateColor> elements that provide the means to specify animated behavior.

16.2.1.1 <animate>

The <animate> element provides a means to animate an attribute over a list of values or using from, to and by.

```
<animate
    id          = ID
    attributeName = <attributeName>
    attributeType = "XML" | "auto"
    targetElement = IDREF
    values       = <list>
    calcMode     = "discrete | linear | paced"
    accumulate   = "sum | none"
    additive     = "sum | replace"
    from         = <value>
    to          = <value>
    by          = <value>
/>
```

id is an XML identifier.

AttributeName is the name of the attribute on which the animation is enacted.

AttributeType is for compatibility purposes with SMIL only.

TargetElement is the identifier of the element containing the attribute to be animated.

Values is a semicolon-separated list of one or more legal values with which to animate the attribute.

CalcMode specifies the interpolation mode for the animation.

Accumulate controls whether the animation is cumulative and each iteration builds upon the last iteration, or whether iterations simply repeat the same set of values.

Additive controls whether the effect of the animation adds to any other animations that may currently be active on the attribute, or whether the animation value simply overrides any other lower priority animations. (See SMIL specification for priority determination).

From specifies a legal starting value for the animation if *values* is not specified.

End specifies a legal ending value for the animation if *values* is not specified.

By specifies a legal relative offset value for the animation if *values* is not specified.

16.2.1.2 <set>

The *<set>* element provides a means to set an attribute to a specific of value for a period of time.

```
<set
    id          = ID
    attributeName = <attributeName>
    attributeType = "XML" | "auto"
    targetElement = IDREF
    to           = <value>
/>
```

The attributes of the *<set>* element are a subset of those in the *<animate>* element. See *<animate>* element for more information.

16.2.1.3 <animateMotion>

The *<animateMotion>* element provides a means to animate an element along a path using a list of values or using from, to and by. *<animateMotion>* has the same attributes as *animate* except that the *attributeName* and *attributeType* for the *target* attribute are not required. *<animateMotion>* acts upon predefined attributes of only certain elements.

If the *targetElement* is *<transformation>* or *<group>* the attribute acted upon is translation.

```
<animateMotion
    as per <animate> without attributeName and attributeType, but plus...
    origin = "default"
/>
```

16.2.1.4 <animateColor>

The *<animateColor>* element provides a means to animate a color attribute using a list of values or using from, to and by.

```
<animateColor
    as per <animate>...
/>
```

16.2.2 SplineAnimation

The SplineAnimation module adds the following attributes to BasicAnimation.

```
<animate
    as per BasicAnimation plus...
    calcMode   = "spline"
    keyTimes   = <list>
    keySplines = <list>
/>
```

The value **spline** is added to the supported values for calcMode. KeyTimes is a semicolon-separated list of time values used to control the pacing of the animation. KeySplines is a set of Bezier control points defining a cubic Bezier function, associated with the keyTimes list, that controls interval pacing.

Refer to the SMIL specification for a complete description of the SplineAnimation module. The module is incorporated into XMT-Ω in full conformance with that specification.

16.2.3 DragAnimation

The DragAnimation module is unique for XMT and defines interactive animation based on input sensor dragging. DragAnimation elements can be used with visual Xmedia elements. A visual element, when the input sensor is held down over it, can be the source of drag animation. DragAnimation for 2D xMedia elements can be plane or disc oriented allowing planar or rotational drag effects. For 3D the drag animation can be plane, cylinder or sphere allowing planar, rotational and cylindrical, or spherical drag effects.

Timing attributes determine when the begin, end, duration etc of the period during which dragging is enabled. During that period dragging can be effected using the pointing device.

Attributes listed below for the various drag animation elements have semantics that are defined in the respective nodes to which the drag animations will be mapped. Autooffset is common to all drag animations and allows the offset to automatically be set to the last output value when the pointing device button is released. Subsequent dragging then takes place from there. By default autooffset is true.

16.2.3.1 <dragPlane>

```
<dragPlane
  maxPosition = <value>
  minPosition = <value>
  autooffset  = "true | false"
  offset      = <value>
/>
```

maxPosition specifies the maxPosition and has default value of “-1 -1”

minPosition specifies the minPosition and has default value of “0 0”

offset specifies the offset and has a default value of “0 0” for 2D contexts and “0 0 0” in 3D contexts.

16.2.3.2 <dragDisc>

```
<dragDisc
  maxAngle   = <angle>
  minAngle   = <angle>
  autooffset = "true | false"
  offset     = <angle>
/>
```

maxAngle specifies the maxAngle and has default value of “-1.0rad”.

minAngle specifies the minAngle and has default value of “0”.

offset specifies the offset and has a default value of “0”.

16.2.3.3 <dragCylinder>

```
<dragCylinder
  diskAngle  = <angle>
  maxAngle   = <angle>
  minAngle   = <angle>
  autooffset = "true | false"
  offset     = <angle>
/>
```

diskAngle specifies the diskAngle and has default value of “0.262rad”.

maxAngle specifies the maxAngle and has default value of “–1.0rad”.

minAngle specifies the minAngle and has default value of “0”.

offset specifies the offset and has a default value of “0”.

16.2.3.4 <dragSphere>

```
<dragSphere  
    autooffset = "true | false"  
    offset     = <angle axis>  
/>
```

offset specifies the offset and has a default value of “0rad 0 1 0”

16.2.4 Mapping Animation to MPEG-4

XMT-Ω will incorporate the SMIL Animation modules however authoring tools will be made responsible to ensure SMIL Animation semantics are preserved.

Animation features can be mapped to MPEG-4 using various means. TimeSensors, Interpolators and Routes provide mechanisms to do value/keyTime animations. BIFS updates for replace field can be used for <set> and may also be used for animation if the updates are frequent enough. BIFS Anim may also be used where appropriate. As long as the Animation semantics are maintained an authoring tool implementation is free to choose any appropriate MPEG-4 function(s) to fit the need. It would however be expected to choose a particular mapping to fit the MPEG-4 “tools” according to a given MPEG-4 profile and level. More complex mappings may be achieved with MPEG-4 player functions that can do run-time computation and decisions, such as MPEG-J and Scripts.

The various drag animations can be mapped to DiscSensor, CylinderSensor, PlaneSensor, PlaneSensor2D and SphereSensor.

Unlike SMIL players, MPEG-4 players do not maintain both a base value and a dynamic presentation value for attributes (fields). MPEG-4 supports only field replacement, whether done by Routes, by BIFS command, or by animation streams. To preserve SMIL Animation semantics the XMT authoring tool will be required to manage and track the attributes state such that the semantics can be honored. However non-deterministic behavior, such as from user driven events, will make this task more difficult and may require the authoring tool to create more complex MPEG-4 constructs to manage this.

The following aspects a SMIL Animation will require attention by the authoring tool:

1. When a field is updated in MPEG-4 the prior value is not retained. When the effect of the animation ends the default behavior in SMIL is to revert back to the authored value. To achieve compatible behavior the authoring tool must add, for example additional BIFS commands, to ensure this happens. To do this the authoring tool must be aware of the authored value and may simulate the playback of the authored presentation so that it can insert a field replacement to put the value back to the authored value. For non-deterministic behavior this may include MPEG-4 Conditional nodes, MPEG-J, or Script nodes to do this that can be activated/run by the player from an appropriate trigger.

Where the XMT authoring environment can predict the former value then the authoring tool should honor SMIL semantics. What degree of complexity the authoring tool uses to map such behavior onto MPEG-4 is left to implementation. Where however such semantics cannot be preserved then the authoring tool should warn the author. In the latter case the tool should also suggest a change in the fill attribute value of the animation element. By changing to fill="freeze" this will allow the final value from the animation to be kept until the media ends.

2. To achieve SMIL Animation compatibility the effect of certain attributes such as accumulate, additive, by, to, and certain calcModes e.g. spline and paced may be computed at compile time. Such computed results would then be used to generate say a series of timed BIFS commands, or a set of interpolator values for example that produce the desired effect. The degree of approximation in such computations is authoring tool implementation dependent. Depending on the target MPEG-4 player complexity it is conceivable that Scripts or MPEG-J could be used as an

alternative so that computations could be done at playback time.

3. In MPEG-4 the result of multiple routes being fired simultaneously into a given field – fan-in – is undefined. If there are multiple animation elements acting simultaneously on an attribute (field) the authoring tool may not be able to generate an MPEG-4 presentation that combines them and maintains SMIL Animation semantics. If the resultant animation is predictable at authoring time or the authoring tool can manage whatever uncertainty remains at run-time then the animation may be converted to MPEG-4 to allow predictable behavior. If the authoring tool cannot provide a predictable outcome then a warning to the author should be generated.
4. Some MPEG-4 nodes do not allow some or all of their fields to be updated e.g. Box and FontStyle. Also Box and Rectangle are very similar nodes but for Box, the size field cannot be updated, whereas for Rectangle node the size field can be updated. To update a Box the whole geometry node would need replacing to change its size, whereas for Rectangle just the size field itself can be replaced. An XMT authoring tool must manage this mapping variability to MPEG-4 as XMT-Ω presents a consistent interface allowing both those size attributes to be animated even though there are underlying differences. For the animation element <set> the attribute size can be mapped to a single Field and Node replacement for Rectangle and Box respectively. <animate> can also be mapped the same way, with an appropriate rate of updates to achieve the animation effect. For Rectangle however there is also the choice of using an Interpolator in the scene to animate its size field. If an authoring tool cannot map an animation using the available MPEG-4 tools for the target profile and level then a warning to the author should be generated.

16.3 XMT-Ω Content Control

SMIL Animation feature comprises four modules; BasicContentControl, CustomTestAttributes, PrefetchControl and SkipContentControl. XMT-Ω will include the features of all four modules.

16.3.1 BasicContentControl

SMIL provides a <switch> element and test attributes that permit content selection to be made from a set of alternative elements. Only the first acceptable element is chosen.

16.3.1.1 System test attributes

XMT-Ω incorporates the set of system test attributes as listed in the SMIL specification. For example systemBitrate and systemLanguage are test attributes defined by SMIL.

16.3.1.2 TermCap test attributes

XMT-Ω adds a set of test attributes that are to be mapped to the TermCap node, ISO/IEC 14496-1 §9.4.2.103. The values of the attributes are integers as defined in §9.4.2.103.2. The attributes apply to xMedia objects where the mapping to MPEG will place the media objects under a switch connected to a TermCap node with the capability and its value set according to the termCap test attribute and its value.

```

TermCapFrameRate
termCapColorDepth
termCapScreenSize
termCapGraphicsHardware
termCapAudioOutputFormat
termCapMaxAudioSamplingRate
termCapSpatialAudioCapability
termCapCPULoad
termCapMemoryLoad

```

ISO/IEC 14496-1:2001/Amd.2:2002(E)

The following table lists the above termCap test attributes. Either the numeric value or the string value (case sensitive) may be used.

| TermCapAttr | val | XMLstring value | Semantics |
|-------------------------------|------------|------------------------|---|
| termCapFrameRate | 0 | unknown | Unknown or can't determine |
| | 1 | 0-5fps | Less than 5fps |
| | 2 | 5-10fps | 5-10fps |
| | 3 | 10-20fps | 10-20fps |
| | 4 | 20-40fps | 20-40fps |
| | 5 | +40fps | More than 40fps |
| termCapColorDepth | 0 | unknown | Unknown or can't determine |
| | 1 | 1bpp | 1bit/pixel |
| | 2 | grayscale | Grayscale |
| | 3 | 3-12bppColor | Color, 3-12bits per pixel |
| | 4 | 12-24bppColor | Color, 12-24bits per pixel |
| | 5 | +24bppColor | Color, more than 24bits per pixel |
| termCapScreenSize | 0 | unknown | Unknown or can't determine |
| | 1 | 0-200lines | Less than 200lines |
| | 2 | 200-400lines | 200-400lines |
| | 3 | 400-800lines | 400-800lines |
| | 4 | 800-1600lines | 800-1600lines |
| | 5 | +1600lines | 1600 or more lines |
| termCapGraphicsHardware | 0 | unknown | Unknown or can't determine |
| | 1 | noAcceleration | No acceleration |
| | 2 | matrix | Matrix multiplication |
| | 3 | matrixTexture0-1M | Matrix multiplication + texture mapping (less than 1M memory) |
| | 4 | matrixTexture1-4M | Matrix multiplication + texture mapping (less than 4M memory) |
| | 5 | matrixTexture+4M | Matrix multiplication + texture mapping (more than 4M memory) |
| termCapAudioOutputFormat | 0 | unknown | Unknown or can't determine |
| | 1 | mono | Mono |
| | 2 | stereoSpeakers | Stereo speakers |
| | 3 | stereoHeadphones | Stereo headphones |
| | 4 | fiveChannelSurround | five-channel surround |
| | 5 | +fiveSpeakers | More than five speakers |
| termCapMaxAudioSamplingRate | 0 | unknown | Unknown or can't determine |
| | 1 | 0-16000Hz | Less than 16000Hz |
| | 2 | 16000-32000Hz | 16000-32000Hz |
| | 3 | 32000-44100Hz | 32000-44100Hz |
| | 4 | 44100-48000Hz | 44100-48000Hz |
| | 5 | +48000Hz | 48000Hz or more |
| termCapSpatialAudioCapability | 0 | unknown | Unknown or can't determine |
| | 1 | noSpatialAudio | No spatial audio |
| | 2 | panningOnly | Panning only |
| | 3 | azimuthOnly | Azimuth only |
| | 4 | full3DSpatialAudio | Full 3-D spatial audio |
| termCapCPULoad | 0 | unknown | Unknown or can't determine |
| | 1 | 0-20% | Less than 20% loaded |
| | 2 | 20-40% | 20-40% loaded |
| | 3 | 40-60% | 40-60% loaded |
| | 4 | 60-80% | 60-80% loaded |
| | 5 | 80-100% | 80-100% loaded |
| TermCapMemoryLoad | 0 | unknown | Unknown or can't determine |
| | 1 | 0-100KB | Less than 100KB free |
| | 2 | 100-500KB | 100KB-500KB free |
| | 3 | 500KB-2MB | 500KB-2MB free |
| | 4 | 2-8MB | 2MB-8MB free |
| | 5 | 8-32MB | 8MB-32MB free |
| | 6 | 32-200MB | 32MB-200MB free |
| | 7 | +200MB | More than 200MB free |

The following elements support the use of termCap test attribute.

Rectangle, circle, text, string, subtitles, points, lines, polygons, curve, img, video, audio, audioClip, box, cone, cylinder, sphere, mesh, group, applicationWindow, inline, xmtaMedia and useMacro

The <use> element is also supported if it is based on the above elements.

16.3.1.3 <switch>

The <switch> element is as per SMIL specification.

```
<switch>
  a list of alternate elements to select from according to test attributes...
</switch>
```

The following are a couple of examples to illustrate its usage. For more information, and more examples, see the SMIL specification.

Selection between audio tracks in different languages.

```
<switch>
  <audio src="audio-english" systemLanguage="en"/>
  <audio src="audio-francais" systemLanguage="fr"/>
  <audio src="audio-dutch" systemLanguage="nl"/>
</switch>
```

Selection between audio tracks of various qualities suitable for different bit-rates.

```
<switch>
  <audio src="audio-goodquality" systemBitRate="44100"/>
  <audio src="audio-mediumquality" systemBitRate="22000"/>
  <audio src="audio"/>
</switch>
```

16.3.2 CustomTestAttributes

XMT-Ω incorporates the custom test attributes as defined by the SMIL specification. Custom test attributes allow authors to define their own test attributes.

16.3.2.1 <customAttributes>

The <customAttributes> element is as per SMIL specification. The element may be present in the document header, <head> section, and contains the definition of available custom test attributes.

16.3.2.2 <customTest>

The <customTest> element is as per SMIL specification. The element defines each custom test attribute.

```
<customTest
  id          = ID
  title       = <string value>
  defaultState = "true | false"
  override    = "allowed | not-allowed | uid-only"
  uid         = uri-reference
/>
```

id is an XML identifier.

title is a user defined label for the test attribute.

defaultState is the initial value for named custom test variable that may be overridden.

override allows the author to block overriding the value or limit the means by which overriding can be done

uid identifies a persistent store for the value of the custom test variable.

16.3.3 PrefetchControl

XMT-Ω incorporates the PrefetchControl module as defined by the SMIL specification. The <prefetch> element allows authors to influence the scheduling of media, primarily to allow the media to be presented quickly in interactive presentations with non-deterministic start times based on events.

16.3.3.1 <prefetch>

The <prefetch> element is as per SMIL specification.

```
<prefetch
    id      = ID
    mediaSize = <bytes-value | percent-value>
    mediaTime = <clock-value | percent-value>
    bandwidth = <bitrate-value | percent-value>
/>
```

id is an XML identifier.

mediaSize specifies how much of the media to prefetch as a function of its size.

mediaTime specifies how much of the media to prefetch as a function of its duration.

bandwidth specifies how much of the network bandwidth to utilize when prefetching.

16.3.4 SkipContentControl

XMT-Ω incorporates the SkipContentControl module as defined by SMIL, and the elements containing the skip-content attribute are also as defined by SMIL.

16.3.5 Mapping Content Control to MPEG-4

Alternate content can be defined using SMIL Content control module.

Certain content, such as alternate languages can be selectable at run-time via MPEG-4 alternate streams identified with language descriptors.

Otherwise selections can be pre-compiled so that language specific MPEG-4 can be output.

Such run-time versus compile-time selection should be under control of the author during a publish stage that would compile the textual format into the required BIFS, OD and media streams etc.

Content control may also be expressed for ratings, bandwidth etc.

16.4 XMT-Ω Layout

XMT-Ω contains layout features that are based on the SMIL Layout features. For XMT-Ω Layout there are no SMIL modules incorporated. The Schema for XMT-Ω Layout is unique to XMT, but it is syntactically similar to SMIL Layout.

16.4.1

16.4.1.1 <layout>

The <layout> element is similar to that of the SMIL specification.

```
<layout
    type      = "xmt/xmt-basic-layout"
```

```
metrics = "pixel | meter"
/
```

type is a string specifying the layout type. The only current valid value “xmt/xmt-basic-layout”.

metrics is a string specifying the metrics used for media dimensions, position etc as per MPEG-4. The valid values are “pixel”, which is the default, or “meter”.

A single, optional *<layout>* element can be placed into the *<head>* of the document. When not present the default layout is as if a *<layout>* had been defined with a default topLayout.

16.4.1.2 <topLayout>

The *<topLayout>* element is similar to that of the SMIL specification. A single topLayout element may be present in the *<layout>*.

```
<topLayout
    backgroundColor = <color value>
    height          = <value>
    width           = <value>
    enableSubtitles = <"true | false">
/
```

backgroundColor is a color value for the background of the topLayout. By default the color is “black” .

height is a string specifying the presentation preferred height in pixels. The attribute contains an optional value such as “480” that defines the height in pixels

width is a string specifying the presentation preferred width in pixels. The attribute contains an optional value such as “640” that defines the width in pixels.

Only if both a *width* and a *height* are specified will the preferred size flag in MPEG-4 systems decoder specific information descriptor be set true, otherwise it will be set false.

enableSubtitles is a boolean that controls whether any *<subtitles>* text is visible or not. This attribute may be animated and by default its value is true.

A *<topLayout>* may contain zero or more *<regions>* as defined below. The *<topLayout>* defines the screen for MPEG-4, see ISO/IEC 14496-1 §9.2.2.2 to 9.2.2.4. The center point of the *<topLayout>* is the origin and is MPEG-4 point 0,0 for 2D.

xMedia objects, or *<group>*s that have no region attribute are placed in the *<topLayout>* and positioned according to the origin. The *<group>*, and the xMedia’s *<transformation>* sub-element, can be used to position the media within the *<topLayout>* where the translation, rotation attributes position the objects just as the Transform/Transfrom2D nodes position the objects in MPEG-4.

16.4.1.3 <region>

The *<region>* element is a similar concept to that of the SMIL specification except that positioning of regions is based on center coordinates with a single attribute size containing both width and height. Having a single center and since size attribute facilitates animation of the regions to allow their positions and size to be changed (animated).

Multiple regions may be defined within the *<topLayout>*. Regions can be defined with regions to allow a hierarchical layout.

A media element, or *<group>* may be associated to a particular region by using the region attribute in the media, or *<group>*. The region is identified by its id or by its regionName. The optional regionName does not need to be unique and hence may be used in conjunction with content control module and alternate layouts to name multiple alternate regions the same. If there are alternate regions with the same name there must only be one that is finally selected by the content control, otherwise the layout is ambiguous.

xMedia objects and <group>s placed into the region are positioned off the center of the region where the translation, rotation attributes position the objects just as the Transform/Transfrom2D nodes position the objects in MPEG-4.

z-index is used to control the layerering of mutiple regions that are inside a single region or topLayout. If no z-index is specified then those regions have a highest order and will be on top. Regions having an identical z-index (and all those that where z-index is not specified are considered identical to each other) are layered in document order with the each new region being layered on top of the prior one in the document order.

```
<region
    id          = ID
    backgroundColor = <color value>
    regionName   = <string>
    translation   = <value>
    size         = <value>
    z-index      = <value>
    soundLevel   = <value>
/>
```

id is an XML identifier.

translation is the coordinates for the center of the region .

size is the width and height of the region.

z-index is used to resolve the layering of overlapping regions in the same region or in a topLayout.

soundLevel is used to set the volume of audio elements placed into the region as per SMIL AudioLayout module.

16.4.2 Mapping Layout to MPEG-4

layout: metrics goes to BIFS config.

topLayout: width and height go to BIFS config. backgroundColor maps to MPEG-4 Background:skycolor or Background2D:backColor depending on whether the content is 2D or 3D. topLayout maps to a Layer2D node or OrderedGroup node for 2D content; or a Layer3D node or Group node for 3D content.

region: maps to layer2D or layer3D node

16.5 XMT-Ω Linking

XMT-Ω defines a single linking element <a> that is similar to the use of the same element in SMIL and HTML. In XMT-Ω this would be mapped to an MPEG-4 Anchor node to another MPEG-4 presentation.

16.5.1 <a>

```
<a
    id    = ID
    href  = <uri-reference>
/>
```

id is an XML identifier.

href is a uri-reference to another valid mpeg-4 presentation.

The <a> linking element can contain one or more xMedia elements, <group> elements, xmtaMedia elements or <use> elements referring to any of the preceding types. The <a> element can be nested such that, for example, a <group> contained several child xMedia element can have an <a> element surrounding the group while an xMedia element(s) in the group also has an <a> element. If a media contained by more than one <a> element it is the one that is closest above the media in the scene hierarchy that will be activated when the media is clicked.

The following is an example where, if either of the two media elements circle or rectangle are clicked, the current presentation will end and the new presentation will be started.

```
<a href="dmif://NewMpeg4Presentation">
  <circle radius="25" .../>
  <rectangle size="100" .../>
</a>
```

16.5.2 Mapping Linking to MPEG-4

Linking provides a high-level representation of the Anchor node which will be used in the mapping to MPEG-4.

16.6 XMT-Ω Extensible Media (xMedia) Objects

Although SMIL provides a useful abstraction for media objects in the Media Object Module, SMIL is more about multimedia player composition rather than multimedia object composition as MPEG-4 is about. For instance, SMIL would render text and let the text player concern itself about font, style, colors etc., whereas MPEG-4 text object includes font, style, alignment, and colors and as such is intimately aware of such detail. A combination of HTML+SMIL would include these text attributes but again HTML has its own media content model.

MPEG-4 also contains 2D elements similar to those that are described in SVG (Scalable Vector Graphics), for example Rectangle and Circle. SVG in fact uses modules from SMIL; content selection and animation. The animation module was jointly developed between SMIL and SVG.

The XMT-Ω format will abstract media objects to include behavior in a manner comparable to SMIL Animation, e.g. `<set attributeName="myRect.color" begin="click" to ="#ff00ee">`. This example would map in MPEG-4 to a TouchSensor on the object that had a route that, via a valuator, set the color of a Rectangle object, named myRect, to the color #ff00ee.

The XMT-Ω syntax and semantics have been designed around extensible media (xMedia) objects. The XMT-Ω defines a set of xMedia elements as basic building blocks for multimedia objects. An xMedia object is defined by an element, such as ``, or `<rectangle>`, which abstracts geometry, with media specific attributes and timing attributes. Elements and attributes defined in the XMT-Ω namespace contains a subset of what is defined in SMIL.

Spatial properties of an xMedia element can be further defined by a set of common child elements: `<transformation>`, `<material>`, `<outline>`, `<chromakey>`, `<texture>`, `<light>`, and `<hotspots>`.

Behavior that are associated with an xMedia element can be defined by a set of animation elements (see the animation section). Events that are associated with an xMedia element (e.g. a mouse click) can be expressed using timing attributes as in SMIL (see the timing section).

An xMedia element also abstracts BIFS, OD commands, media streams, etc.

16.6.1 Generic xMedia object

The following defines a generic 2D/3D xMedia object. For media object specific attributes, such as rectangle's size or circle's radius, see the individual xMedia object definitions below. Timing attributes are defined in the timing section.

```
<xMediaObject %media_specific_attributes %timing_attributes

<transformation
  center = "cx cy cz"
  rotation = "angle ax ay az"
  scale = "sx sy sz"
  scaleOrientation = "angle ox oy oz"
  translation = "x y z"
  visibility = "true | false"
  order = numeric_value
  billboard = true | false
  billboardAxis = "bx by bz"
 />
<material
```

```

    ambientIntensity = "i"
    diffuseColor = color
    color = color
    shininess = "s"
    specularColor = color
    transparency = "alpha"
    filled="true | false"
  >
  <outline
    color="#00ff00"
    width="2"
    style="dash-dot"
  />
</material>
<chromakey
  isKeyed = "true | false"
  isRGB = "true | false"
  keyColor = "rgb | yuv"
  lowThreshold = "l"
  highThreshold = "h"
  transparency = "alpha"
/>
<texture
  src = image | video
  <encodingHints> Hints to encode source </encodingHints>
  repeatS = "true | false"
  repeatT = "true | false"
  center = "x y"
  rotation = "angle"
  scale = "x y"
  translation = "x y"
/>
<light
  ambientIntensity = "i"
  color = color
  direction = "x y z"
  intensity = "i"
  on = "true | false"
/>
<hotspots>
  %media_elements
</hotspots>
</mediaObject>

```

Spatial properties of an xMedia object can be defined by its child elements, such as the transformation, material, outline, chromakey, texture, light elements. Behavior of an xMedia object upon user interactions are defined by the hotspots elements.

SMIL attributes *erase* and *sensitivity* are supported in XMT, for compatibility, but only for the SMIL default values of whenDone and opaque respectively.

16.6.1.1 <transformation>

```

<transformation
  center = "cx cy cz"
  rotation = "angle ax ay az"
  scale = "sx sy sz"
  scaleOrientation = "angle ox oy oz"
  translation = "x y z"
  visibility = "true | false"
  order = numeric_value
  billboard = true | false
  billboardAxis = "bx by bz"
/>

```

A <transformation> element allows the object to be positioned, scaled etc (mapped to a Transform or Transform2D node). See ISO/IEC 14496-1 §9.4.2.106 and §9.4.2.107 for definition. The center, rotation, scale, scaleOrientation and translation attributes are mapped to their MPEG-4 node counterparts (Note: rotation attribute maps to rotationAngle field for Transform2D node). Z-coordinates and axis for rotation and scale are only for 3D nodes.

The object can be shown and hidden (MPEG-4 object is mapped under an MPEG-4 switch node for this purpose) using a visibility attribute (familiar to DHTML authors).

Order (See ISO/IEC 14496-1 §9.4.2.76 OrderedGroup) is used to explicitly control the rendering order of the 2D media object within a <group> element or in the default group. The default group is the group that is used to map the region, or topLayout. Once one media object in a group has an order value all other objects will have a default order value of 0.0 if not explicitly defined. Order field is used primarily to control the rendering order of 2D media objects, since they have no z-index. For 3D objects, having a z-index, the order field is used only for the case of co-planar surfaces to determine which surface to render first. For 2D media objects without an order, or for objects of the same order value, the media objects will be rendered according to their temporal occurrence where later items are rendered on top. Items occurring at the same time will be rendered in the order they appear in the XMT document (document order).

Billboard and billboardAxis are for 3D media objects only and define media object to be a billboard type as if a child of a Billboard node. See ISO/IEC 14496-1 §9.4.2.18 where billboardAxis is the axisOfRotation.

16.6.1.2 <material>

```
<material
    ambientIntensity = "i"
    diffuseColor = color
    color = color
    shininess = "s"
    specularColor = color
    transparency = "alpha"
    filled="true | false"
/>
```

A <material> element specifies the material for a visual media. This is mapped either to a Material or Material2D node depending on whether the media object is a 3D or 2D type respectively - see ISO/IEC 14496-1 §9.4.2.69 and §9.4.2.70 for definition. The color is mapped to emissiveColor, all other attributes are mapped to their MPEG-4 node counterparts. AmbientIntensity, diffuseColor, shininess and specularColor only for 3D media objects; filled attribute is only for 2D media objects. The <material> can contain an <outline> which is only for 2D media objects.

16.6.1.2.1 <outline>

```
<outline
    color="#00ff00"
    width="2"
    style="dash-dot"
/>
```

The <outline> element contains the style (dotted, dashed, etc.), the thickness and color of a line that is drawn around the periphery of a 2D media object. This is mapped to LineProperties node - see ISO/IEC 14496-1 §9.4.2.66 for definition.

16.6.1.3 <chromakey>

```
<chromakey
    isKeyed = "true | false"
    isRGB = "true | false"
    keyColor = "rgb | yuv"
    lowThreshold = "l"
    highThreshold = "h"
    transparency = "alpha"
/>
```

The <chromakey> element applies only to or <video>. This defines a chroma key color for shaped image/video extraction. This is mapped to the MaterialKey node - see ISO/IEC 14496-1 §9.4.2.71 for definition.

16.6.1.4 <texture>

```
<texture
    src = image | video
    repeatsS = "true | false"
    repeatT = "true | false"
    center = "x y"
    rotation = "angle"
```

```

    scale = "x y"
    translation = "x y"
/>

```

The <texture> element allows any 3D or 2D visual media object, except and <video>, to be textured. This is mapped either to an ImageTexture or a MovieTexture node, along with a TextureTransform node depending on whether the src is an image or a video - see ISO/IEC 14496-1 §9.4.2.57 and §9.4.2.72 and §9.4.2.103 for definitions. The repeatS and repeatT attributes are mapped to the ImageTexture or MovieTexture node. Center, rotation, scale and translation are mapped to the TextureTransform node.

16.6.1.5 <light>

```

<light
  ambientIntensity = "i"
  color = color
  direction = "x y z"
  intensity = "i"
  on = "true | false"
/>

```

The <light> element is valid only for 3D media objects. This is mapped to a DirectionalLight - see ISO/IEC 14496-1 §9.4.2.41 for definition

16.6.1.6 <hotspots>

The <hotspots> element allows media elements, such as circle, rectangle etc or a <group> of objects to be used as hotspot links. The <hotspots> element allows these media elements to be added to any other media elements and designated as a hotspot. An <a> linking tag, see the linking section, or other animation element, see the animation section, would be associated with the hotspot media element to make it active. By nesting the hotspot media elements this way they will track the media object they are the hotspot for if the media object moves or is scaled etc. (The hotspots media elements are attached under the Transform/Transform2D that is mapped by the <transformation> element).

In MPEG-4, any shape can have a TouchSensor attached and can therefore be used as a hotspot. Both 2D and 3D shapes can be used and so a wider range of shapes is available for use in the same way that area can be used. In addition, the MPEG-4 shapes can be made translucent and partially visible; visible as translucent outlines etc. If the shapes use (share) the same appearance, then control of hotspot visibility can easily be provided in a presentation. It may be advantageous, at the authoring level, to identify shapes used as a Hotspot's. Note also the shapes can be timed and provide changing active buttons over time.

As the <hotspots> element contains xMedia objects, whose syntax permits the use of a region, it would create problems and makes no sense if the region attribute on an xMedia hotspot object specified a different region than the group it belonged to. To ensure this cannot happen the region attribute of an xMedia object will be ignored when it is contained in a <hotspots> element.

An object used as a hotspot, although is a media element, cannot contain further hotspots itself.

The media objects used as hotspots are translated according to the 0,0,(0) origin of the media object containing the hotspots and are transformed along with any transformation(s) that act upon that media object.

Media elements in the hotspots can also be enclosed by <anchor> element to allow hotspots to link to other content.

16.6.2 <rectangle>

```
<rectangle size="width height"/>
```

The <rectangle> element is the XMT-Ω representation of a rectangular media object.

16.6.2.1 Element content

NOTE: All 2D attributes of the <material> element are applicable. Also, the transparency attribute of the <material> element is meaningful only if the object is filled, i.e., only if the filled attribute of the <material> element is specified. An unfilled object can be defined by specifying the <outline> element (see section on *The <outline>*

element) and the filled attribute to be false. A filled object with an outline can be defined by specifying both the filled attribute to be true and using the <outline> element.

16.6.3 <circle>

```
<circle radius="radius"/>
```

The <circle> element defines the circular media object.

NOTE: See subsection on the *Element content of The <rectangle> element*.

16.6.4 <text>

```
<text src = "">
</text>
```

This is a text element that is directly compatible with SMIL media object <text>.

Note: as the src attribute is a URI a text string can be coded directly in the text element using a data uri of the form such as <text src="data:text/plain,this is some text">

16.6.5 <string>

```
<string textLines=""A first line of text";
          "A second line etc if needed and so on"">
  <fontStyle .../>
</string>
```

This maps to an MPEG-4 text node and provides a mechanism to include text strings directly rather than via an src.

See ISO/IEC 14496-1 §9.4.2.53 for definition of fontStyle which is equivalent to the MPEG-4 node

```
<fontStyle
  family = "Helvetica Bold"; "SERIF | SANS | TYPEWRITER"
  horizontal = "true | false"
  justify = "BEGIN | FIRST | MIDDLE | END; BEGIN | FIRST | MIDDLE | END"
  language = ""
  leftToRight = "true | false"
  size = 24.0
  spacing = 1.0
  style = "PLAIN | BOLD | ITALIC | BOLDITALIC"
  topToBottom = "true | false"
/>
```

16.6.6 <subtitles>

Subtitles are text that are used for accessibility on audio streams. Under player client selection sub-titles may be enabled or disabled and are available as a separate object from text for this purpose. An attribute in <topLayout> called *enableSubtitles* is available to be animated for this purpose.

Like the <text> element the <subtitles> contains a <fontStyle>. The <fontStyle> may be directly here or a <use> that references a <fontstyle> in the <defs>. The latter case allows more than one <subtitles> text block to share the same font style.

```
<subtitles textLines=""A first line of subtitles";
          "A second line if wanted etc."">
  <fontStyle .../>
</subtitles>
```

16.6.7

```
<img src = "">
  <encodingHints> Hints to encode source </encodingHints>
</img>
```

The `` element is directly compatible with SMIL media object ``. The `` element is an imageTexture mapped onto a Bitmap geometry.

Note: `` is always mapped to Bitmap node. For other mappings an image can be textured onto a rectangle, or other visual media objects, using the `<texture>` element.

The `<material>`, `<outline>` and `<texture>` elements are not valid.

16.6.7.1 JPEG image sequence

For a sequence of images, when they are coded as JPEGs, it is possible to map into MPEG-4 the images to individual ObjectDescriptors or into the same ObjectDescriptor with one JPEG as a single timed Access Unit. The exact mapping to MPEG-4 is not dictated by XMT- Ω however `<deliveryHints>` may be used on each `` to specify it is part of a common elementary stream. This is accomplished by using `<param>` with the name "ImageSequence" to denote the images are part of a common sequence were the sequence is identified using an identification in the value

```
<param name="ImageSequence" value="A unique stream identification"/>
```

For example:

```
<seq>
  
    <deliveryHints>
      <param name="ImageSequence" value="slideShow1"/>
    </deliveryHints>
  </img>
  
    <deliveryHints>
      <param name="ImageSequence" value="slideShow1"/>
    </deliveryHints>
  </img>
  
    <deliveryHints>
      <param name="ImageSequence" value="slideShow1"/>
    </deliveryHints>
  </img>
</seq>
```

In the above example the first two image sources were JPEG and the latter image source was a BMP. This will be re-coded as a JPEG during the mapping to MPEG-4 so that the `<deliveryHints>` for the image sequence can be honored.

16.6.7.2 Images as a PixelTexture

Although many images will be mapped to MPEG-4 as ImageTextures with an Elementary Stream conveying the pixels it is possible to map an image to a PixelTexture. For small images for use as icons, cursors etc mapping as a PixelTexture eliminates the need for an elementary stream for the image, plus mapping to PixelTexture allows non-rectangular transparent images to be created. To specify that an `` should be encoded as a PixelTexture the following `<encodingHints>` are to be used.

In the `<targetFormat>` specify `<param>` with a name of "PixelTexture" and one value from the following = "mono", "monoAlpha", "color" or "colorAlpha".

16.6.8 <video>

```
<video src ="" >
  <encodingHints> Hints to encode source </encodingHints>
</video>
```

The `<video>` element is directly compatible with SMIL media object `<video>`. The `<video>` element is a movieTexture mapped onto a Bitmap geometry.

Note: `<video>` is always mapped to Bitmap node. For other mappings a video can be textured onto a rectangle, or other visual media objects, using the `<texture>` element.

The `<material>`, `<outline>` and `<texture>` elements are not valid.

16.6.9 `<points>`

```
<points
    color = "rgb; rgb; rgb"
    coord = "x y z; x y z; x y z"
/>
```

See ISO/IEC 14496-1 §9.4.2.83 PointSet and 1 §9.4.2.84 PointSet2D for definition of the attributes which are equivalent to the MPEG-4 node fields. The color attribute is an array of colors one for each coordinate in the coord attribute. The coord attribute has either “x y” pairs or “x y z” triplets depending on whether the element is used as a 2D media element or 3D element. As per MPEG-4 Systems if no color is specified then the color used for the points will be as specified by the `<material>`.

16.6.10 `<lines>`

```
<lines
    color = "rgb; rgb; rgb"
    coord = "x y z; x y z; x y z"
    colorIndex = ""
    colorPerVertex = "true | false"
    coordIndex = ""
/>
```

See ISO/IEC 14496-1 §9.4.2.60 IndexedLineSet and §9.4.2.61 IndexedLineSet2D for definition of the attributes which are equivalent to the MPEG-4 node fields. The coord attribute has either “x y” pairs or “x y z” triplets depending on whether the element is used as a 2D media element or 3D element. As per MPEG-4 Systems if no color is specified then the color used for the lines will be as specified by the `<material>`.

16.6.11 `<polygons>`

```
<polygons
    coord = "x y; x y; x y"
    coordIndex = ""
    color = "rgb; rgb; rgb"
    colorIndex = ""
    colorPerVertex = "true | false"
    texCoord = "x y; x y; x y"
    texCoordIndex = ""
/>
```

See ISO/IEC 14496-1 §9.4.2.59 IndexedFaceSet2D MPEG-4 node fields. The coord attribute has “x y” pairs as the element is used as a 2D media element. As per MPEG-4 Systems if no color is specified then the color used for the polygons will be as specified by the `<material>`.

`<material>` 2D attributes filled, color and alpha and `<outline>` apply.

16.6.12 `<curve>`

```
<curve
    points = "x y; x y; x y"
    fineness =
    type =
/>
```

See ISO/IEC 14496-1 §9.4.2.36 Curve2D for definition of the attributes which are equivalent to the MPEG-4 node fields.

16.6.13 <audio>

```
<audio src = "">
  <sound.../>
  <encodingHints> Hints to encode source </encodingHints>
</audio>
```

The <audio> element is directly compatible with SMIL media object <audio>.

For compatibility with SMIL the volume of the audio may be controlled through the soundLevel attribute of the region into which the audio is placed.

Alternatively a <sound> element may be used to control the sound intensity, location etc. When a <sound> element is used the soundLevel attribute of the region is ignored for that <audio> element.

The <sound> element is as follows

```
<sound
  location    = "x y z"
  intensity   = value
  spatialize  = "true | false"
  direction   = "x y z"
  maxBack     = "value"
  maxFront    = "value"
  minBack     = "value"
  minFront    = "value"
  priority    = "value"
 />
```

where location (with x and y values), intensity and spatialize are valid for use in 2D contexts, all attributes being valid for use in 3D contexts.

Where <sound> is not used, intensity is set through the soundLevel attribute in the region, otherwise it is as if a default <sound> were present with default values for the other attributes. The default values being the same as the Sound or Sound2D node defaults dependent upon context.

16.6.14 <audioClip>

```
<audioClip src = "">
  <sound.../>
  <encodingHints> Hints to encode source </encodingHints>
</audioClip>
```

See ISO/IEC 14496-1 §9.4.2.8 AudioClip. Note that the MPEG-4 fields relating to timing are managed now via the XMT timing attributes.

The volume of the audioClip is either controlled through the soundLevel attribute of the region into which the audioClip is placed or via a <sound> child element, see <audio> element above for <sound> definition.

16.6.15 <box>

```
<box size="width height depth"/>
```

The <box> element defines a box media object.

NOTE: All attributes of the <material> and <transformation> element applies. The <texture> element applies while <outline> does not.

16.6.16 <cone>

```
<cone radius="r"
      height="h"
```

```
    hasSide="true|false"
    hasBase="true|false"/>
```

The <cone> element defines a 3D conical media object. This is mapped to the Cone node – see ISO/IEC 14496-1 §9.4.2.31 for definition. The attribute radius maps to field bottomRadius; hasSide and hasBase map to side and bottom respectively.

NOTE: See the subsection *Element content of The <box> element*.

16.6.17 <cylinder>

```
<cylinder radius="r"
           height="h"
           hasSide="true|false"
           hasBase="true|false"
           hasTop = "true|false"/>
```

The <cylinder> element defines a cylinder media object. This is mapped to the Cylinder node - see ISO/IEC 14496-1 §9.4.2.37 for definition. The attributes hasSide, hasBase and hasTop map to side, bottom and top respectively.

NOTE: See the subsection *Element content of The <box> element*.

16.6.18 <sphere>

```
<sphere radius="r"/>
```

The <sphere> element defines a spherical media object. This is mapped to the Sphere node - see ISO/IEC 14496-1 §9.4.2.96 for definition.

NOTE: See the subsection *Element content of The <box> element*.

16.6.19 <mesh>

```
<mesh
  coord = "x y z; x y z; x y z"
  coordIndex = ""
  color = "rgb; rgb; rgb"
  colorIndex = ""
  colorPerVertex = "true | false"
  normal = "x y z; x y z; x y z"
  normalIndex = ""
  normalPerVertex = "true | false"
  texCoord = "x y; x y; x y"
  texCoordIndex = ""
  creaseAngle = "0.0"
  ccw = "true | false"
  convex = "true | false"
  solid = "true | false"
/>
```

See ISO/IEC 14496-1 §9.4.2.58 IndexedFaceSet MPEG-4 node fields. The coord attribute has “x y z” triplets as the element is used as a 3D media element.

16.6.20 <inline>

```
<inline src = "">
</inline>
```

See ISO/IEC 14496-1 §9.4.2.62 Inline. Allows a complete MPEG-4 presentation to be included (in-lined) in the scene.

16.6.21 <applicationWnbow>

```
<applicationWindow %timing_attributes
  src = ""
  description = ""
  parameter = ""
  size = "w h"
/>
```

An applicationWindow media object. This is mapped to the ApplicationWindow node - see ISO/IEC 14496-1 §9.4.2.6 for definition.

16.6.22 <delay>

```
<delay %timing_attributes/>
```

A delay (null media object). This object contains no sub-elements.

16.7 SMIL media object modules in XMT-Ω

The SMIL Media Object modules for MediaClipping, MediaClipMarkers and MediaDescription are incorporated into XMT-Ω.

16.7.1 MediaClipping

This module is fully incorporated. Using clipBegin and clipEnd attributes a sub-clip of a continuous media object can be defined as offsets from the start of the media that identify the beginning and end of a sub-clip.

16.7.2 MediaClipMarkers

This module is fully incorporated. This module defines clips using named time points rather than using clock values as used by clipBegin and clipEnd. Named time points can be mapped to MPEG-4 Segment Descriptor.

16.7.3 MediaDescription

This module is fully incorporated. This module contains attributes to provide a brief description of the content (abstract) the author, copyright and a title.

16.8 XMT-Ω Media Augmentation objects

The following objects act like media objects in that they are part of scene graph hierarchy. The objects act to augment the media objects.

16.8.1 <fog>

```
<fog %timing_attributes
  color = ""
  fogType = "LINEAR | EXPONENTIAL"
  visibilityRange = ""
/>
```

The <fog> element is a media augmentation object. This is mapped to the Fog node - see ISO/IEC 14496-1 §9.4.2.52 for definition.

16.8.2 <pointLight>

```
<pointLight
  ambientIntensity = "i"
  attenuation = "a0 a1 a2"
  color = color
  intensity = "i"
  location = "x y z"
```

```

    radius = "r"
    on = "true | false"
/>

```

The <pointLight> element is a media augmentation object. This is mapped to the PointLight node - see ISO/IEC 14496-1 §9.4.2.82 for definition.

16.8.3 <spotLight>

```

<spotLight
    ambientIntensity = "i"
    attenuation = "a0 a1 a2"
    beamWidth = angle
    color = color
    cutOffAngle = angle
    direction = "x y z"
    intensity = "i"
    location = "x y z"
    radius = "r"
    on = "true | false"
/>

```

The <spotLight> element is a media augmentation object. This is mapped to the SpotLight node - see ISO/IEC 14496-1 §9.4.2.98 for definition.

16.8.4 <backdrop>

```

<backdrop color="" src = ""
    <encodingHints> Hints to encode source </encodingHints>
</backdrop>

```

The <backdrop> element is a media augmentation object. This is mapped to the Background2D node - see ISO/IEC 14496-1 §9.4.2.15 for definition.

A <backdrop> will either bind to the entire scene or to a <group> when the <backdrop> is a child element of a <group> and the <group> has a size. See 16.9.1 <group> for more detail.

16.8.5 <background>

```

<background
    skyColor=""
    skyAngle=""
    groundColor=""
    groundAngle=""
    backSrc = ""
    bottomSrc = ""
    frontSrc = ""
    leftSrc = ""
    rightSrc = ""
    topSrc = ""
    <encodingHints> Hints to encode source </encodingHints>
</background>

```

The <background> element is a media augmentation object. This is mapped to the Background node - see ISO/IEC 14496-1 §9.4.2.14 for definition.

One or more <encodingHints> elements can be used to supply encoding hints for the image sources. There are a maximum of six images for the back, bottom, front, left, right and top. An encoding hint applies to the respective image(s) by supplying a name/value pair in the <targetFormat> element of the <EncodingHints> such as <param name="src" value="front"> which means that the encoding hints refer to the frontSrc image. The encoding hints will apply to more than one image if more than one name/value pair with name="src" is used within a single encoding hints target format.

A <background> will either bind to the entire scene or to a <group> when the <background> is a child element of a <group> and the <group> has a size. See 16.9.1 <group> for more detail.

16.9 XMT-Ω Media Group object

The <group> object acts like a media object. It groups other media and media augmentation objects together such that they can be manipulated as a single larger composite media object within the scene graph hierarchy.

16.9.1 <group>

Objects can be grouped and positioned through the group construct as defined in this section. This allows a group of objects to manipulated as a whole, e.g. moved together, scaled or made visibility.

```
<group %timing_attributes
  id = ""
  center = "cx cy cz"
  rotation = "angle ax ay az"
  scale = "sx sy sz"
  scaleOrientation = "angle ox oy oz"
  translation = "x y z"
  visibility = "true | false"
  order = numeric_value
  billboard = true | false
  billboardAxis = "bx by bz"
  size = "w h"
  backgroundColor=""
  collide = "true | false"
/>
```

The <group> element has most of its attributes in common with <transformation> as defined in the media elements. The <group> acts like a <par> time container.

The size, background color and collide attributes are unique to <group>.

The size and background attributes may be used to limit the rendering dimensions of the group and to provide a backgroundColor within those dimensions. The backgroundColor attribute is ignored when the size attribute is not present. A size of "-1.0 -1.0" will size the group to the dimensions of its parent; have one specified size and the other as dimension as -1 will cause the dimension that is -1 to be sized to its parent. The parent being either a <group> that is above this one in the hierarchy or if there are none then to the region or layout into which it is placed.

The collide attribute may be used in a 3D context and will cause collision detection amongst the children when set true. A collide event will be raised the group when a collision is detected.

Objects are rendered within the <group> according to the same rules as defined for the media objects <transformation> element.

```
<group id="myGroup" begin="0s">
  <rectangle size="10 10" begin="2s" dur="5s"/>
  <circle radius="30" dur="12s"/>
</group>
```

In the above example the circle appears first at t=0s. At t=2s the rectangle is added and appears on top of the circle. It is removed 5s later and the circle remains visible for a further 7s when the group ends after its children end at 12s.

```
<group id="myGroup" begin="0s">
  <rectangle size="50 50" dur="5s"/>
  <circle radius="30" dur="12s"/>
</group>
```

In the above example the rectangle and circle both start at t="0s". The circle will now appear on top as the media objects in this case are rendered in document order.

Rendering order can however be different if order attribute is specified. In the following example the circle begins at the same time as the rectangle but the rectangle will be rendered on top as it has a greater order value than the circle.

```
<group id="myGroup" begin="0s">
  <rectangle size="10 10" dur="5s">
    <transformation order="2.0"/>
  </rectangle>
  <circle radius="30" dur="12s">
    <transformation order="1.0"/>
  </circle>
</group>
```

A `<group>` can also be nested within another `<group>` to create any desired hierarchy. The `order` attribute in the `<group>` controls its rendering order within its parent.

The `<group>` element collects elements together as a group so that the set of objects can be acted upon as a whole using the attributes of the `<group>`. For example the complete group can be translated or scaled. The `<group>` element also supports the `region` attribute, like the xMedia objects, so that the group of objects placed in a given region. As the `<group>` element can contain xMedia objects, that may also have a `region` attribute, it would create problems if the `region` attribute on a child xMedia object specified a different region than the group it belonged to. To ensure this cannot happen the `region` attribute of an xMedia object will be ignored when its parent is a group element and the `region` will be determined solely by the `region` attribute on the `<group>` element.

If a `<group>` has a `size` attribute specified, if the `size` field is animated (`<set>` or `<animate>`), or if a `<backdrop>` or `<background>` is present as a child element of `<group>` then the `<group>` shall be mapped to a Layer2D or Layer3D as appropriate, or the mapping shall behave as if this were the case. For example in a very basic profile the Layer nodes may not be there, then the XMT-O can simulate the required mapping using nodes that are available or alert the author if an adequate mapping cannot be achieved. This mapping specification, to behave as if the `<group>` is mapped to Layer2D/3D, is principally to ensure that the `<backdrop>` or `<background>` will bind to the `<group>` and not to the entire scene. A `<background>` or `<backdrop>` that is not a child element of a `<group>` will form the background to the entire scene.

16.10 XMT-Ω custom XMT-A Media objects

The following construct defines a custom media object using XMT-A nodes, descriptor commands etc. The construct allows complicated custom media objects and behavior to be specified and also allows for XMT-A capabilities to be incorporated that have no equivalent representation in XMT-Ω.

16.10.1 `<xmtaMedia>`

```
<xmtaMedia %simple_timing_attributes region="">
  id="" type="2D | 3D | Audio" hasOD="true | false">
  <nodes>
    <Group> or <OrderedGroup>
      <children>
        Visual, or Audio nodes etc
      </children>
    </Group> or </OrderedGroup>
    <ROUTE.../>
    <ROUTE.../>
  </nodes>
  <cmds>
    Zero or more <par> BIFS, OD, ES, IPMP commands etc and
    StreamSources
  </cmds>
</xmtaMedia>
```

An `<xmtaMedia>` element defines a custom media object. Attributes include support for simple timing support and `region` which allows the object to be placed in the optionally designated layout region. Simple timing is BasicInline Timing module as per SMIL, i.e. `begin`, `end` and `dur` with simple offset timing only where the intrinsic duration of an `xmtaMedia` element is 0s. The `type` attribute specifies whether the media is of type 2D, 3D or audio. This information allows XMT-Ω to create the necessary framework within which to place the media object. The `hasOD`

attribute indicates whether there are OD commands contained in the `xmtMedia` that would require an OD stream to be defined in the `InitialObjectDescriptor`.

To control the custom media's position, its visibility etc the `<xmtMedia>` element should be placed within an XMT- Ω `<group>` element. A duration must be specified for the media as its duration cannot necessarily be determined by the nodes and cmdts.

The custom media definition is in two parts:

The first part, contained in the `<nodes>` element is an XMT-A `<Group>` or `<OrderedGroup>` node that may contain any valid XMT-A nodes as well as any ROUTEs needed to connect the nodes.

The second part, the optional `<cmds>` element, contains any necessary XMT-A Object Descriptor Framework elements to support or augment the nodes, as well as any BIFS commands to update the nodes. All BIFS commands, except for Replace Scene may be used. All OD Framework commands may be used and streams may be defined for MPEG-J, OCI, IPMP. The `<par>` element may be used to time the commands as defined by XMT-A. The time defined by the `<par>` element will be offset by the overall begin time of the `<xmtMedia>` object.

16.11 XMT- Ω MetaInformation

XMT- Ω incorporates the SMIL MetaInformation module as defined by SMIL.

16.11.1

16.11.1.1 <metadata>

The `<metadata>` element is as per SMIL specification.

```
<metadata>
    hosts RDF elements
</metadata>
```

The `metadata` element hosts RDF metadata as per the Resource Description Framework (RDF), see the SMIL specification for further information.

16.11.1.2 <meta>

The `<meta>` element is as per SMIL specification. The element specifies a single property/value pair in the name and content attributes, respectively.

```
<meta
    id      = ID
    name   = <value>
    content = <value>
/>
```

id is an XML identifier.

name is the name of a property

content is the value of that named property

16.11.2 Mapping MetaInformation to MPEG-4

MetaInformation can be retained in the XMT document instance. MetaInformation can also be encoded as OCI.

16.12 XMT- Ω Structure

XMT- Ω defines a document structure that is similar, but not identical, to the SMIL structure. XMT- Ω has added a `<defs>` element into the `<head>`, much like SVG, to allow definitions for later re-use within the presentation.

16.12.1 <XMT-O>

<XMT-O> can contain a single <head> and <body> in that order.

16.12.2 <head>

The XMT-Ω can contain <meta>, <customAttributes>, <metadata>, <layout>, <transition>, <defs> and <macros>

16.12.3 <body>

And then there is the content itself. A key feature of the content is the high-level constructs for the audio-visual objects. These constructs not only describe the objects but also include behavior.

Like SMIL the <body> element has the timing semantics of a <seq> timing container.

16.13 XMT-Ω DEFNS

XMT- Ω provides a means to define commonly used elements for a document.

16.13.1 <defs>

The XMT-Ω <head> can contain a <defs> element. Elements within the <defs> section can be as follows:

- xMedia elements
- xMedia augmentation elements
- <group>
- <xmtaMedia>
- <material>, <chromakey>, <texture>, <light> sub-elements from xMedia elements
- <outline> (from <material>)
- <fontStyle> element (from <text>)

The id of an element allows and element, and any contained elements, to be referenced in the <body>.

```

<defs>
  <fontStyle id="myBold"  family="SERIF" size="24" style="BOLD"/>
  <rectangle id="bigRect" size="200 300">
    <material id="myRed" color="#FF0000" filled="true"/>
  </rectangle>
  <circle id="smallCirc" radius="1">
    <use xlink:href="#myRed"/>
  </circle>
  <material id="myWhite" color="white" filled="true"/>
</defs>
<body>
  <string textLines=""My line of text"">
    <use xlink:href="#myBold"/>
  </string>
  <use xlink:href="#bigRect"/>
  <circle radius="50">
    <use xlink:href="#myWhite"/>
  </circle>
  <circle radius="20">
    <transformation translation="10 10"/>
    <use xlink:href="#myRed"/>
  </circle>
  <use xlink:href="#smallCirc"/>
</body>

```

Elements within the <defs> section can also contain animation elements such as <set>, <animate> and <animateColor>. This would normally be used to provide materials whose colors pulsated, small spinning objects that can be re-used etc. The timeline for the animation elements is the document instance timeline that begins at

t=0s. So for example setting a color in a material to red at 20s would do so at t=20s and would have the effect of turning all objects red that used the material. No timing is allowed on any other elements, except for the XMT-A <par> timing in an xmtaMedia object which is also relative to the document instance timeline that begins at t=0s, like the animation.

Only discrete xMedia elements are supported in the <defs> section; i.e. no continuous media such as video or audio.

The region attribute is not supported for elements in the <defs> section, the respective <use> will later define the region for that instance (as well as timing etc).

16.13.2 <use>

The <use> elements can only substitute in positions where the element(s) would occur if defined directly rather than via the <use>. A <use> can also occur in the <defs> section as part of a larger set of elements making a defined entity, but not as an element immediately under the <defs>, i.e an entity being defined can be created from a combination of original elements as well as other entities defined in the <defs> section.

When a <use> substitutes for an xMedia object it can have attributes that are supported by the xMedia object. These include timing attributes and region.

No child elements are permitted in the <use>; a <use> is identical to its definition. To size and position a <use> when it is an xMedia type the <use> may be placed under a <group> and the translation, scale, center attributes etc of the <group>

16.13.3 Mapping DEFS to MPEG-4

Elements in the <defs> section and the <use> maps to the MPEG-4 DEF and USE attributes.

16.14 XMT-Ω MACROS

XMT-Ω provides a means to define custom objects with virtual attributes and optional virtual values for these attributes. This facility provides the author a means to define a (complex) object and create many similar instances, say only varying only by a single virtual attribute value. Each high level object, or macro, can have many elements forming the object and the macro provides a mechanism to define virtual attributes by which the object may be manipulated rather than using the actual attributes of the media objects that comprise the macro. This not only provides a level of abstraction but allows a one to many relationship between the virtual attribute and the actual attributes to which it refers. Abstract virtual values may be defined for each virtual attribute that allow the attribute to be manipulated using values that are more appropriate to the abstraction level.

16.14.1 <macros>

The XMT-Ω <head> can contain a <macros> element. Within the <macros> section individual <macro> objects can be defined:

16.14.2 <macro>

The XMT-Ω <macro> allows an object to be defined along with virtual attributes that are aliases for one or more actual attributes in the object itself. Such attributes can also have virtual values defined along with the corresponding actual values that the actual attributes in the object need to be set to.

Each <macro> can contain one or more <attrib> elements that define virtual attributes, followed by a single media <group> element that contains xMedia objects etc., as can normally be contained in a <group>. Timing and region attributes that could normally be present on a <group> element are not permitted when used in this <macro> context and are ignored if present. <use> elements are however permitted within the <group> to be part of the macro. Animation elements may be present to animate attributes within the <group> content.

Each virtual attribute, as defined by <attrib>, contains a <targets> element that lists the actual attributes of the elements contained within the <group> that are to be set when the virtual attribute value is set. <targets> contains a list of one or more <target> elements that identify an element and the attribute therein that is to be set. Each <target> can be identified by an id that allows it to be referenced for the creation of virtual values. Each <attrib> can contain zero or more virtual values following the <targets> list. If the actual attribute types are not identical then the virtual attribute can only be manipulated using virtual values and hence in this case at least one virtual value should

be defined. Each virtual value element <value> contains a name attribute so as to create a named value. This named value can be used with the virtual attribute to set the virtual attribute value. A <value> contains a list of <put> elements that defines values to be set to each of the <target> attributes. A virtual value can be derived from another using a base="" attribute. In this case the <put> values override those listed from the virtual value upon which the derived value is based.

This is a very simple example defining a button in a 2D context. One virtual attribute is created called 'faceColor' and this is defined as being two actual target attributes in the object. In this case the value types are the same (both color) although they do not have to be. Then some (optional) abstract values are defined, one of which uses an already defined value as a base and makes a delta to it (brightpink is based off murkypink). Another virtual attribute 'dropShadow' shows a virtual attribute that is comprised of actual attributes whose types are not the same.

```

<macro name="button">
  <attrib name="faceColor">
    <targets>
      <target id="f1" targetElement="mat1"
             attributeName="color"/>
      <target id="f2" targetElement="mat2"
             attributeName="color"/>
    </targets>
    <value name="murkypink">
      <put target="f1" value="#ff8800"/>
      <put target="f2" value="#f55800"/>
    </value>
    <value name="brightpink" base="murkypink">
      <put target="f2" value="#ff0000"/>
    </value>
    <value name="muddyblue">
      <put target="f1" value="#ff88ff"/>
      <put target="f2" value="#5677ef"/>
    </value>
  </attrib>
  <attrib name="dropShadow">
    <targets>
      <target id="f11" targetElement="matd"
             attributeName="color"/>
      <target id="f12" targetElement="t2dshadow"
             attributeName="translation"/>
    </targets>
    <value name="bottomRightDark">
      <put target="f11" value="#020202"/>
      <put target="f12" value="4 -4"/>
    </value>
    <value name="topLeftLight">
      <put target="f11" value="#404040"/>
      <put target="f12" value="-5 5"/>
    </value>
  </attrib>
  <group>
    Here is the actual xMedia shapes as already defined by XMT-Ω
    that form the actual object and has material elements with ids
    mat1 and mat2, etc. that are referred to above.
  </group>
</macro>
```

16.14.3 <useMacro>

To use a <macro> it can be instantiated using <useMacro> and the virtual attributes can be given values. Where the values are base types e.g. color, and all actual attributes are of the same type, any base type value from XMT-Ω can be used to instantiate it, in this case the color #00ff00. The virtual attribute can then be animated in the normal way using <set> and <animate>. And for animation too base type values can be used if the actual attributes are of the same type, and if not only virtual values. For example

```
<useMacro xlink:href="#button" faceColor="#00ff00">
```

```

<set      begin="5s"  attributeName="faceColor"  to="murkypink"/>
<animate begin="25s" attributeName="faceColor"  to="#0000ff" dur="20s"/>
<set      begin="30s" attributeName="dropShadow" to="topLeftLight"/>
</useMacro>

```

Where the virtual attributes are a mix of many types the only values supported will be the virtual values, which will list the complete set of actual values to set in the actual attributes to make that virtual value.

All the common attributes that can be used on an xMedia element are present for <useMacro>. These attributes include timing, region etc.

A <useMacro> may be used anywhere a <group> can be used (the <macro> content being formed using <group>). <useMacro>s can also be present in the <defs> section.

16.15 XMT-Ω Timing and Synchronization

XMT- Ω Objects are timed using the SMIL Timing and Synchronization modules. We'll use the terms SMIL timing and XMT- Ω timing (or simply XMT timing) interchangeably in the rest of this document and distinguish them when necessary. The syntax and semantics of timing elements and attributes are as per SMIL specification unless otherwise specified.

SMIL Timing (and thus XMT- Ω timing) defines elements and attributes to coordinate and synchronize the presentation of media objects over time. Three synchronization elements, called as time containers, support timing by grouping their contained children into coordinated timelines:

- The <seq> element plays the child elements one after another in sequence.
- The <excl> element plays one child at a time, but does not impose any order.
- The <par> element plays child elements as a group (allowing “parallel” playback).

XMT- Ω Timing attributes specify element's timing behavior (as per SMIL specification). The essential timing attributes are :

- begin: specifies the begin time of an element in a variety of ways, ranging from simple clock times to an event (e.g. a mouse-click) occurrence.
- dur: specifies the duration of an element.
- end: specifies the end time of an element in a variety of ways as in the begin time.
- min: specifies the minimum active duration of an element.
- max: specifies the maximum active duration of an element.

An example:

```

<par begin="0s" dur="15s">
  <rectangle . . . />
  <img . . . />
  <seq>
    <text. . . />
    <circle. . . />
  </seq>
</par>

```

In this example, <par> and <seq> are used to denote required timing and they will be mapped to BIFS updates at the required times along with OD and media streams as required by the xMedia objects.

The XMT-Ω also supports the following timing attributes:

- repeatDur, repeatCount: specifies how long, and how often the element is to repeat.
- fill: specifies how an element can be extended (e.g. by freezing the final state) to fill gaps in a presentation.
- endsync: controls the active duration of the par and excl containers with respect to the active duration(s) of child element(s). It allows the time container to “co-end,” or end together, with selected child element(s).
- restart, restartDefault: controls restart behavior of an element
- syncBehavior, syncBehaviorDefault: defines the runtime synchronization behavior for an element.

- SyncMaster: if set to true, this forces other elements in the time container to synchronize their playback to this element.

SMIL Timing and Synchronization support is broken down into a number of semantically related elements, attributes and attribute values. XMT- Ω , in re-using the SMIL Timing and Synchronization modules, support most of the SMIL timing constructs, including time containers, sync-arcs, event based timing, stream dependencies, etc. The XMT- Ω also fully incorporates SMIL Time Manipulations module. The XMT- Ω supports the FlexTime model in MPEG-4 by reusing the SMIL timing modules with two additional XMT- Ω specific attributes, namely flexBehavior, flexBehaviorDefault.

As is the case with SMIL, not all XMT- Ω elements may specify their timing behavior using timing attributes. Those XMT- Ω elements that support timing attributes are: All xMedia elements, all animation elements, time container elements, and the group element.

16.15.1 SMIL Timing and Synchronization Modules in XMT- Ω

16.15.1.1 AccessKeyTiming

Fully incorporated: InputSensor node can be used to provide the necessary keyboard input function.

16.15.1.2 BasicInlineTiming

Fully incorporated but for restricted use of indefinite: dur attribute with all allowed values, and begin and end attributes with simple offset values.

Note that the “indefinite”, while supported for dur attribute as the duration can be terminated by an event such as click, supporting this value for begin and end attributes is not currently feasible for XMT and MPEG-4 as there is no defined external interface in MPEG-4 terminals to trigger the begin or end. SMIL, being a W3C standard, would support using the DOM to trigger the elements begin or end and hence in SMIL indefinite begin or end value is feasible.

16.15.1.3 BasicTimeContainers

Fully incorporated: par and seq elements, and fill, endsync attributes on them. The fill attribute on a time container describes its display behavior, and endsync describes its end conditions.

An example:

```
<par endsync="first">
  <video src="intro.mpg" dur="media"/>
  <audio src="intro.au" dur="media"/>
</par>
```

In this example the par time container ends when any of the child elements ends its intrinsic media duration dur="media." The endsync attribute on a time container may also be "all," "last," or id-value to end the time container when all the child elements end, when the last one that has been activated ends, or when the child element specified by the id-value ends, respectively.

16.15.1.4 EventTiming

Fully incorporated: begin and end with event values. In addition to 2D interactive behavior, XMT- Ω also supports user interaction with 3D objects. These behaviors are specified in a manner similar to SMIL. An event source is routed to its event sink by using the timing attributes begin or end. As an example, the code fragment below shows that a circle appears when an object with an identifier m1 is clicked. The mouse click event associated with the "m1" object is routed to cause the circle to appear.

Example:

```
<circle radius="20" begin="m1.click">
  <material color="red"/>
</circle>
```

Note: Begin and end times activated by user interaction, i.e. not defined at compile time, cannot be easily supported for media streams at the current level of MPEG-4. It requires the proposed MediaControl node. Support may be possible however for objects composed entirely from BIFS (such as circle, rectangle, etc.) using conditional nodes that can be activated at run-time via user interaction.

Note: In general the main time-line must be defined at compile-time as the scheduling of transmission cannot be managed interactively at run-time given today's MPEG-4. This situation is in changing as amendments being worked on will bring new functionalities. OD execution semantics may facilitate client-side data requests for transmission. The proposed MediaControl node and/or ServerCommands will also alleviate the situation and allow much more dynamic stream control during playback.

16.15.1.4.1 XMT events

In addition to supporting basic events like mouse click, mouse up, mouse down, mouse over and mouse out, XMT allows users to specify other behaviors beyond SMIL for interacting with MPEG-4 objects in both 2D and 3D spaces. These behaviors are specified as suffix to the identifier of an object, such as "M1.mousedrag", "M1.click", etc, with the exception of collision. The collide suffix will be associated with a collision group, instead of with an object.

Table 4 – XMT supported behaviors and suffixes

| Behavior/Event | XMT defined event symbols | SMIL defined event symbols |
|-----------------------------------|---------------------------|----------------------------|
| Mouse click | click | activateEvent |
| Mouse up | mouseup | |
| Mouse down | mousedown | |
| Mouse out | mouseout | |
| Mouse over | mouseover | |
| Detecting visibility of an object | viewable | |
| Detecting proximity of an object | near | |
| Detecting collision of objects | collide | |
| Observed begin of object | | beginEvent |
| Observed end of object | | endEvent |
| Object has begun a repeat cycle | | repeatEvent |

The table above lists the XMT behavior and their corresponding suffixes. XMT has defined unique event symbols to support events not defined in SMIL, but also supports some of the event symbols defined by the SMIL language. In some cases there are two symbols for the same event, for example click and activateEvent. An authoring tool should support both and treat them as synonyms. Click is potentially more readable but activateEvent is more interoperable with the SMIL language. Dependent on how the authored content is to be used an author can choose to use either.

Suffixes such as click, mouseup, mousedown, mouseout, mouseover, mousedrag and rotate are associated with the identifiers of both 2D and 3D objects. Collide applies to 3D objects.

To detect the collision of 3D media objects with other 3D media objects the objects are placed within a <group> that has the collide attribute set to true. The sample XMT fragment below shows that the audio starts playing when the two objects with identifiers s1 and b1 collide.

```

<head>
  <layout metrics="pixel">
    <topLayout width="640" height="480"/>
  </layout>
</head>
<body>
  <group id="CG1" collide="true">
    <sphere id="s1" radius="50">
      <transformation translation="10 10 10"/>
    </sphere>
    <box id="b1" size="10 10 10">
      <transformation translation="-10 10 10">
        <animateMotion to="10 10 10" dur="5s"/>
      </transformation>
    </box>
  </group>
  <audio src="myaudio.wav" begin="CG1.collide"/>

```

```
</body>
```

Additional constraints on an object's behavior/ event can be specified via escape to the XMT-A construct. For instance, we may want to specify the region within which an object can be dragged, or perhaps we want to specify the time duration during which certain events may occur, with the exception of collision event. This can be achieved by using the escape mechanism described below.

16.15.1.5 ExclTimeContainers

Partially incorporated: excl time container and fill, endsync attributes on it. <excl> supports only one stream playing according to selection. Certain mappings may be possible where such content is played under an MPEG-4 switch node where the switch selection is by user interaction.

An example:

```
<par>
  <video id="vid" .../>
  <excl>
    <par begin="englishBtn.click">
      <audio begin=vid.begin src="english.wav" />
    </par>
    <par begin="frenchBtn.click">
      <audio begin=vid.begin src="french.wav" />
    </par>
    <par begin="koreanBtn.click">
      <audio begin=vid.begin src="korean.wav" />
    </par>
  </excl>
</par>
```

In this example, multiple languages are available for a video. Only one language is played at a time with the most recent selection replacing the previous language choice, if any. The three par elements are children of the excl contained and so at most only one can play at any given time. The audio child in each par is defined to begin when the video begins. Each audio can be active (or heard) only when its parent time container is active; which begins with a click on a button media object somewhere. This means that when the par begins, the audio will start playing at some point in the middle of the audio clip in sync with the video. I.e. the audio's actual computed begin time is coincident with the start of the video, but it cannot play (become active and be heard) until its parent is active, begun by a click, and so the actual observed start is some point into the audio as if it began playing when the video began. So the language track for the video can be switched and stay in sync with the video.

Note that the priorityClass element to control the pausing behavior of children of the excl will not be incorporated by XMT. The child elements of an excl will be considered to be peers with the default peers behavior "stop."

16.15.1.6 FillDefault

Fully incorporated: the fillDefault attribute defines the default value for the display behavior for an element when its active duration ends. The element may be frozen at the final state, or it may no longer be presented (i.e., its effect is removed from the presentation).

16.15.1.7 MediaMarkerTiming

Fully incorporated: begin and end with media marker values allow elements to begin and end based upon media markers contained in the source content.

Example:

```
<audio begin="longvideo.marker(#video1)" ... />
```

The audio will begin at the time of the named marker #video1 in the longvideo element. This allows synchronization between streaming media segments and other elements using named markers. The named markers can map to proposed SegmentDescriptors in MPEG-4.

16.15.1.8 MinMaxTiming

Fully incorporated: min and max attributes provide the author with a way to control the lower and upper bound of the element's active play duration.

Example:

```
<video end="foo.click" min="5s" max="20s" ... />
```

The video will end when foo is clicked, but it will play at least for 5 seconds (even if foo is clicked earlier) but no more than 20 seconds (i.e., the video will end at 20 seconds even if foo is not clicked).

16.15.1.9 MultiArcTiming

Fully incorporated: the begin and end attributes may have multiple semicolon-separated values.

Example:

```
<par>
  <video begin="5s; foo.end; foo.click" .../>
</par>
```

The video will begin 5 seconds after the par begins, when "foo" ends, or when "foo" is clicked, whichever happens first.

16.15.1.10 RepeatTiming

Fully incorporated: repeatDur, repeatCount attributes to allow repeating an element for a given duration or number of iterations.

Example:

```
<audio src="sound.wav" dur="2.5s" repeatDur="7s" .../>
```

The audio will play for a total of 7 seconds. It will play fully two times, followed by a fractional part (.5) of the 2 seconds.

16.15.1.11 RepeatValueTiming

Fully incorporated: begin and end with repeat values to allow elements to begin and end in response to repeat events with a specific iteration value.

An Example:

```
<audio begin="foo.repeat(3)" ... />
```

Audio begins when the foo element repeats the third time.

16.15.1.12 RestartDefault

Fully incorporated: restartDefault attribute for specifying default restart semantics.

16.15.1.13 RestartTiming

Fully incorporated: restart attribute for controlling the begin behavior of an element that has previously begun.

Example:

```
<audio begin="foo.click" dur="3s" restart="whenNotActive" ... />
```

This example will begin repeating the audio clip and play for 3 seconds when “foo” is clicked but restart will be triggered only if the click occurs when this element is not active. The restart attribute value can also be “always,” or “never,” as per SMIL specification.

16.15.1.14 SyncBehavior

Partially incorporated: syncBehavior attribute specifies the runtime synchronization behavior. Note that syncTolerance is not incorporated by XMT.

Example:

```
<par>
  <text ... />
  <par id="speech" syncBehavior="canSlip" >
    <video syncBehavior="locked" ... />
    <audio syncBehavior="locked" ... />
  </par>
</par>
```

The audio and video elements are defined with hard or “locked” sync to maintain lip sync, but the “speech” par time container is allowed to slip. If either the video or audio must pause due to delivery problems, the entire “speech” par will pause, to keep the entire timeline in sync. However the rest of the document, including the animation element will continue to play normally.

SMIL runtime synchronization behavior syncBehavior=“canSlip | locked” would map to independent MPEG-4 OCRs and MPEG-4 streams using a common OCR respectively. The syncTolerance attribute will not be supported by XMT.

16.15.1.15 SyncBehaviorDefault

Partially incorporated: syncBehaviorDefault attribute to specify default synchronization behavior for elements and all descendants. The syncToleranceDefault will not be supported.

16.15.1.16 SyncbaseTiming

Fully incorporated: begin and end with syncbase values to allow elements to begin and end relative to each other.

Example:

```
<par>
  <video id=vid ... />
  <img begin=vid.begin end=vid.end ... />
</par>
```

The img will begin and end at the same time as the video.

16.15.1.17 SyncMaster

Partially incorporated: syncMaster attribute to specify the synchronization master for a timeline.

SMIL syncMaster may be used in MPEG-4 to define the stream that supplies the OCR reference.

16.16 XMT-Ω Time Manipulations

16.16.1 SMIL TimeManipulations Module

Fully incorporated : accelerate, decelerate, autoReverse, and speed attributes to allow time manipulations.

Example:

```
<seq speed="2.0">
  <video dur="10s" .../>
  <video dur="10s" .../>
</seq>
```

In this example the entire contents of the sequence will play twice as fast. Each video child will play at twice the normal rate, and so will only last for 5 seconds.

Example:

```
<img ... >
  <animateMotion dur="8s" accelerate=".25" decelerate=".25" ... />
</img>
```

A motion path will accelerate up from a standstill over the first 2 seconds, run at a faster than normal rate for 4 seconds, and then decelerate smoothly to a stop during the last 2 seconds. This makes the motion animation look more realistic.

16.16.2 FlexTime Support

MPEG-4 FlexTime model is fully supported by the XMT- Ω timing model by extending the SMIL timing behavior with flexBehavior and flexBehaviorDefault attributes. The flexBehavior attribute specifies preferred modes of stretching or shrinking of the playback duration of an element in order to satisfy synchronization requirements to compensate for unpredictable delays in a delivery system, utilizing some amount of flexibility given by the author. Note, that whereas stretching or shrinking the duration of continuous media, e.g. for video, implies respectively slowing down or speeding up playback, for discrete media such as a still image, shrinking or stretching is merely adjusting the rendering period to be shorter or longer.

As such the flexBehavior attribute specifies whether (and if so how) the corresponding element can remain in a flexible synchronization relationship to the parent time container. The flexBehavior works in conjunction with the min and max attributes, where the min and max values provide lower and upper bounds on the active duration as specified in the SMIL timing model. The flextime support in XMT allows the “flexed” element to adjust its playback speed according to the preferred modes of stretching or shrinking, while allowing the length of the active playback duration to be anywhere between the min and max.

We will call an element “flexed” if it specifies the flexBehavior attribute with non-default values, where default values are stretch/shrink mode=“normal” indicating that no stretching or shrinking is to be done.

Note that the flextime support does not guarantee synchronization. Flexibility on a flexed element is bounded by the min and max, and thus any delay or wait needs to be timed within the limits. For instance, if a network congestion delay occurs on a flexed media element, its rendering can wait using the min/max flexibility provided that the rest of the synchronization requirements can still be met. But if there is a delay beyond an allowable limit, synchronization will simply be broken. For guaranteed synchronization, syncBehavior attribute can be used, which describes for each element whether it must remain in a hard sync relationship to the parent time container. But syncBehavior does not alter the active duration of an element as flexBehavior does. It delays the parent time container begin time until it is ready to proceed.

16.16.2.1 The flexBehavior attribute

The flexBehavior attribute allows authors to specify preferred ways to stretch (slow down) or shrink (speed up) the active duration of an element and its descendants to satisfy synchronization requirements.

The default value of flexBehavior is “default” which means that the value is specified by flexBehaviorDefault. If flexBehaviorDefault is not specified it defaults to the value of “inherit; inherit”. A document that defines neither of these attributes will have flexBehavior=“normal ; normal” behavior for all timed elements.

flexBehavior ::= stretchBehaviorValueList “;” shrinkBehaviorValueList | “default”

A semicolon separated pair of two lists, the first is the stretchBehaviorValue list and the second is the shrinkBehaviorValueList.

stretchBehaviorValueList ::= stretchBehaviorValue (“,” stretchBehaviorValueList)?

A comma separated list of stretchBehaviorValues in preferred order.

shrinkBehaviorValueList ::= shrinkBehaviorValue (“,” shrinkBehaviorValueList)?

A comma separated list of shrinkBehaviorValues in preferred order.

stretchBehaviorValue ::= “hold” | “linear” | “repeat” | “normal”

“hold” will hold on the last frame, or freeze the element in order to increase the active duration, “linear” will slow down the duration linearly (e.g., reducing the video frame rate), “repeat” will repeat the element duration to increase its active duration, and “normal” signals XMT that there is no flexBehavior extension to the SMIL based XMT timing behavior.

`shrinkBehaviorValue ::= "stop" | "linear" | "normal"`

“stop” will stop the element’s active duration in order to speed it up, “linear” will speed up the active duration, linearly (e.g., increasing the video frame rate), “normal” signals XMT that there is no flexBehavior extension to the SMIL based XMT timing behavior.

Example:

```
<par>
  <audio .../>
  <video min="5s" max="10s" flexBehavior="linear, hold; linear, stop" .../>
</par>
```

In this example, the video can slow down or speed up to increase or decrease the active duration if synchronization requirements cannot otherwise be met. It can slow down preferably by linearly adjusting the frame rate, or if linear stretching is difficult, it can freeze the last frame and hold on to it to increase the active duration. Similarly, it can reduce the active duration by linearly adjusting the frame rate, but if linear speed up is not possible, it can stop when necessary.

Flexed elements can map to MPEG-4 using TemporalGroup and TemporalTransform nodes.

Consider a slightly more complicated example:

```
<seq begin="0s" flexBehavior="linear, hold; linear, stop" min="14s" max="18s" ...>
  <img min="4s" dur="6s" max="12s" .../>
  <par .../>
    <audio dur="10s" min="8s" max="15s" .../>
    <video dur="10s" min="8s" max="15s" .../>
  </par>
</seq>
```

In this example, when all is well, the img begins when the seq time container begins, displays for 6 seconds, and the par container begins and immediately audio and video will begin and play for 10 seconds, after which the par container ends and so does the seq container. The total active duration of the seq container is then $6+10=16$ seconds which is within the bounds of min and max on the container, and hence everything is fine.

But suppose that the seq container begins at the specified time at zero second, but the img is delayed by 2 seconds, i.e., it arrives 2 seconds after the seq container begins. Note that in this example the specified begin times of the img and the seq container coincide, i.e., the timeline of the img’s active duration starts running as the seq container becomes active. The player has two choices at this point.

One is to display the img for as close to “optimal” (as specified in dur) duration 6 seconds after its arrival (making its active duration to 8 seconds) and continue with the rest. This is possible since there still is a chance (by looking ahead to the par container) to complete the par container in 10 seconds and thus finish the outermost seq container in its max duration, 18 seconds. Alternatively, it can compensate for the 2 second delay as much as it can up-front, by cutting the playback duration of the img, in this case to 4 seconds after its arrival (making its active duration to 6 seconds), and continue with the par container as if there was no delay assuming that the audio and video are there in time.

Note that a player can make either choice, whether to compensate for a delay as early as possible or to as late as possible. Suppose our player decides to choose the latter approach to compensate for a delay as soon as it can. But to make a point let’s further suppose that the audio arrives in time but the video is late. At this point the player has to take yet another adaptive action. There are two things the player has to do: to hold onto the audio in the (decoder) buffer and wait for the video to arrive so the audio and the video can begin together in sync. Assuming that the amount of audio buffer has been set to its maximum requirement, the player will decide how long it can wait for the arrival of the video by respecting the following constraints:

1. the max duration to which the active duration of the img can be stretched,
2. the min duration of the video, and
3. the max duration of the seq container.

In our example, the img can be stretched to as long as the max 12 seconds. But if the img is stretched to display for 12 seconds, and since the seq container specifies its max duration to be 18 seconds, this leaves only 6 seconds for the par container, and this violates the min constraints specified for the audio and video, min="8s."

Clearly, the constraints should be solved consistently. One solution is: to stretch the img's active duration to 10 seconds, allowing the video to arrive as late as 10 seconds into the seq container begin time, holding onto the audio while waiting. There are three cases we need to consider depending on when the late video arrives:

1. it arrives before the max wait time: adjust the video audio active duration accordingly and speed up the playback according to the flexBehavior values,
2. it arrives at exactly the max wait time, the video/audio active duration becomes the min duration and speed up the playback accordingly.
3. the wait time expires: at this point synchronization is broken. The audio will play for the min duration at 10 seconds and the par container will end when audio's active duration ends. The flextime model behaves as if the video node starts at that time, but the player will not render the video and will discard the stream if it arrives later.

16.16.2.2 The flexBehaviorDefault attribute

The flexBehaviorDefault attribute specifies default flexBehavior behavior for elements and all descendants.

Example:

```
<par flexBehaviorDefault="normal; normal" .../>
```

By setting the flexBehaviorDefault to be "normal; normal" the author can specify that the default flexBehavior behavior on the par and its descendants is no stretching/shrinking (unless otherwise specified).

Example:

```
<par flexBehaviorDefault="linear, repeat, hold; linear, stop" .../>
```

In this example, the par container and all its descendants, unless otherwise specified, will be flexed according to the preferred stretch/shrink modes as specified.

Like fillDefault the flexBehaviorDefault also supports the value "inherit" so that stretchBehaviorList and shrinkBehaviorList are inherited. Eg flexBehaviorDefault="inherit; linear, stop" will inherit stretchBehaviorList with new shrinkBehaviorList defined and flexBehaviorDefault="inherit; inherit" will inherit both sets of lists etc. The default value of flexBehaviorDefault is "inherit; inherit"

16.17 XMT-Ω Transitions

SMIL Transitions feature comprises three modules; BasicTransitions, InlineTransitions and TransitionModifiers. XMT-Ω will include the features of all BasicTransitions and InlineTransitions modules only.

16.17.1 BasicTransitions

16.17.1.1 <transition>

The <transition> element is as per SMIL specification. The element defines a single transition class.

```
<transition
    id          = ID
    type        = <value>
    subtype     = <value>
    startProgress = <value>
    endProgress  = <value>
    direction    = "forward" | "reverse"
    fadecolor   = <color value>
/>
```

id is an XML identifier.

type is a type, or family, of transition

subtype is the subtype of transition within the family

startProgress is the amount of progress through the transition at which to begin execution, specified as a number between 0.0 and 1.0

endProgress is the amount of progress through the transition at which to end execution, specified as a number between 0.0 and 1.0

direction is the direction in which the transition will run

fadecolor if the type of the transition is “fade” with subtype “fadeToColor” or “fadeFromColor” then this attribute specifies the starting or ending color of the fade.

16.17.1.2 <param>

The <param> element is as per SMIL specification. The element supports an authoring tool to define its own custom transitions by providing a generic mechanism to supply parameters to the transition to control the effects.

```
<param
    id      = ID
    name   = <value>
    value  = <value>
/>
```

id is an XML identifier.

name is the name of a parameter that controls an aspect of the transition effect

value is the value to supply to that named parameter

16.17.1.3 Applying transitions to media elements

The transIn and transOut attributes are incorporated as per SMIL specification. A media with a transition specify transIn will occur at the beginning of a media elements active duration whereas with transOut it will occur at the end.

16.17.2 InlineTransitions

16.17.2.1 <transitionFilter>

The <transitionFilter> element is as per SMIL specification. The element animates the progress of a filter behavior (transition).

```
<transitionFilter
    id          = ID
    type        = <value>
    subtype     = <value>
    mode        = "in" | "out"
    fadecolor   = <color value>
    from        = <value>
    to          = <value>
    by          = <value>
    values      = <list>
    calcMode    = "discrete | linear | paced"
    targetElement = IDREF
/>
```

id is an XML identifier.

type is a type, or family, of transition

subtype is the subtype of transition within the family

fadecolor if the type of the transition is “fade” with subtype “fadeToColor” or “fadeFromColor” then this attribute specifies the starting or ending color of the fade.

from is the amount of progress through the transition at which to begin execution, specified as a number between 0.0 and 1.0

to is the amount of progress through the transition at which to end execution, specified as a number between 0.0 and 1.0

by is a relative offset value for the amount of progress of the transition

values is a semicolon-separated list of one or more legal values specifying the progress of the transition.

calcMode specifies the interpolation mode for the progress of the transition.

targetElement is the identifier of the element containing the attribute to be animated.

16.17.3 Mapping Transitions to MPEG-4

Fade transitions can be mapped using transparency and color animation.

Slide and push wipes are mapped by animating the position of the object(s).

Other effects can be achieved by animating with texture Transformations, Layer2D/3D, MatteTexture etc., potentially even in combinations.

16.18 XMT-Ω Tool considerations

MPEG-4 authoring format includes notation to allow hints for compression or other format conversions where needed. For example video compression may define compression parameters that allow frame rate and/or quality hints to be specified by the author for various bandwidths. This allows, for example, frame rate to be preferred over quality or vice versa. Video may also be converted to scalable layers. Images may not only be compressed but hints could be given to crop them to reduce size as appropriate.

Such authoring could result in either run-time or compile-time alternatives as also discussed in Content Control above. Such selection of mappings during compilation (encoding to MPEG-4) may be done with interactive prompts during the compilation phase, or may be based on project settings, and in conjunction with test attributes whose values can be specified in the <head> of the document.

16.19 XMT-Ω Examples

This section contains examples of the proposed high-level format and a mapping into MPEG-4 nodes.

16.19.1 Circle with finite duration color animation on mouse press

The following example shows a Circle whose color changes over a 2s duration beginning when the mouse button is pressed down.

Using the XMT-Ω format the circle is simply defined and is given an animate section that describes a linear interpolation using three color values that starts on a mouseDown event and has duration of 2s.

```
<circle id="myCircle" radius="20"
    <transformation
        visibility="true"
        translation="24 50"/>
    <material color="#ee0000" filled="true">
        <animateColor attributeName="color" dur="2s"
            begin="myCircle.click"
            values="#ee0000; #ffcc45; #ffffff" keyTimes="0; 0.3; 1"
            calcMode="linear" />
    </material>
</circle>
```

Using a VRML-like syntax the MPEG-4 nodes to map the XMT-Ω format description above could be done as follows. First there is a switch (MPEG-4 Switch as apposed to SMIL <switch>) so the entire object can be hidden or shown (visibility=true attribute above). The Circle is the basic pattern of Shape containing appearance and geometry, where geometry is a Circle and appearance contains a Material2D describing the color. The Circle (Shape) is set under a Transform2D to position it. To sense mouse activity we need a touchSensor and to define the duration of the color change we need a TimeSensor. Then there is a ColorInterpolator for the color changing. To make the behavior work we must route the TouchSensor to the TimeSensor, to start the TimeSensor when the mouse is pressed. Then we route the fractional output of the TimeSensor to the input of the ColorInterpolator; and finally the output of the ColorInterpolator to the emissiveColor field of the Circles Material2D. Not forgetting of course to DEF the requisite nodes so we can setup the routes.

```

Switch {
    whichchoice 0
    choice [
        Transform2D {
            translation 24 50
            children [
                Shape {
                    appearance Appearance {
                        material DEF CircleMat Material2D {
                            emissiveColor 0.93 0.0 0.0
                            filled TRUE
                        }
                    }
                    geometry Circle {
                        radius 20
                    }
                }
                DEF Touch TouchSensor {}
                DEF Timer TimeSensor {
                    cycleInterval 2
                }
                DEF Coloring ColorInterpolator {
                    key [0.0 0.3 1.0]
                    keyValue [ 0.93 0.0 0.0,
                               1.0 0.93 0.27,
                               1.0 1.0 1.0 ]
                }
            ]
        }
    ]
}

Route Touch.touchTime to Timer.startTime
Route Timer.fraction_changed to Coloring.set_fraction
Route Coloring.value_Changed to CircleMat.emissiveColor

```

16.19.2 An example to show BIFS, OD and media stream mapping

```

<seq begin="20s" dur="10s">
    <img id="Image1" dur="5s" />
    <img id="Image2" dur="2s" />
    <img id="Image3" />
</seq>

```

The above example shows a segment of a presentation that begins at 20s and has three images in shown one after the other. The first image starts at t=20s and lasts for the specified duration of 5s. At t=25s the second starts and lasts for 2s. The third and final image starts at t=27s and has its duration controlled by the overall <seq> time container that specifies the sequence lasts for 10s. As the first and second images consume 7s of the 10s there are 3s left for the third image.

This is mapped to the following MPEG-4 BIFS, OD and media streams. The mapping shows the sequence of commands but the detail of the nodes contained in the BIFS has been omitted for clarity.

| | |
|-------|---|
| t=20s | OD Update for Image1 media stream |
| t=20s | Media data for Image1 |
| t=20s | BIFS Command to insert nodes for Image1 |

| | |
|-------|---|
| t=25s | OD Delete for Image1 media stream and OD Update for Image2 media stream |
| t=25s | Media data for Image2 |
| t=25s | BIFS Command to delete nodes for Image1 and insert nodes for Image2 |
| t=27s | OD Delete for Image2 media stream and OD Update for Image3 media stream |
| t=27s | Media data for Image3 |
| t=27s | BIFS Command to delete nodes for Image2 and insert nodes for Image3 |
| t=30s | BIFS Command to delete nodes for Image3 |
| t=30s | OD Delete for Image3 media stream |

Note that the timing above assumes instantaneous delivery and that timing would require modification by an MPEG-4 server to assure that media data transmission times are allowed for.

16.20 XMT-Ω Data Types

16.20.1 Basic data types

Attributes may be single values, a list of single values or a list of lists. A single value for example is a float, or a single compound datatype for example color, which is three floats, and translation which is two or three floats for 2D and 3D contexts respectively. A list is set of single values, where each value is separated by a semi-colon from the subsequent value. A list of lists is a set of lists, where each list is separated by a colon from the subsequent list.

16.20.1.1 Color

An XMT-Ω color value can be specified in one of the following forms

1. As a list of three floating point values each in the range 0.0 to 1.0, e.g. "1.0 0.5 0.75". This is the same format as used in XMT-A
2. In the #RRGGBB hex-style form as is commonly used in html pages to specify color e.g. "#FF80C0"
3. As one of the standard color names from either the list of HTML colors defined by the W3C or from the set as defined by the XConsortium that includes the extended set of HTML colors used by the popular web browsers e.g. "red", "peachpuff", "LightGoldenRod". In XMT-Ω no spaces are allowed in the names and the names are case-insensitive. The complete list of XConsortium defined color names can be found in the /usr/lib/X11/rgb.txt supplied with XWindows. This includes alternate spellings of "grey", "gray" and colors with numeric suffices from 1 to 4 e.g. "blue1", plus the complete range of gray from 1 through 100, e.g. "gray67". Note: In the standard set of HTML colors there are four names that are also defined by XConsortium and the colors are different. For these identically named colors the HTML color value is used; the colors being purple, maroon, green and gray.

16.20.1.2 Angles

Angles are specified, by default, in degrees with a positive value resulting in anti-clockwise rotation. The suffix deg for degrees is optional but may be explicitly specified. Angles may also be specified in grad and radians using the suffixes grad and rad respectively. The following examples all show a rotation of 90 degrees.

```
rotation = "90"  
rotation = "90deg"  
rotation = "1.571rad"  
rotation = "100grad"
```

16.20.1.3 Strings

Many attributes are specified as a sequence of characters – a string. For all cases other than those listed below the string can be entered directly as an attribute with no special treatment. However for attributes that may contain more than one string, where each string may contain spaces, each string must be surrounded by ". The attributes where such strings can occur are *textLines* attribute in <string> and <subtitles>, and *family* attribute from <fontstyle>. Quotes within a string must be escaped as per the example below.

```
textLines="Line one"  
textLines="First line"; "A second line"  
textLines="He said, "A string with an embedded quotes" that must be escaped."
```

16.21 XMT-Ω Node coverage

This section tabulates the MPEG-4 nodes and how they are/might be used in mapping from XMT-Ω to MPEG-4. This table is mainly for illustration and give an idea of what's covered by XMT-Ω. The actual use and mapping are subject to change and implementation variance (XMT-Ω defines intent and allows implementation some choice in handling the 'compilation into MPEG-4').

| | |
|---------------------------|--|
| AcousticMaterial | |
| AcousticScene | |
| Anchor | Used in mapping <a> linking module |
| AnimationStream | May be used by Animation module |
| Appearance | Implicitly created when defining visual media elements |
| ApplicationWindow | Used to map <applicationWindow> |
| AudioBuffer | |
| AudioClip | Used to map <audioClip> |
| AudioDelay | |
| AudioFX | |
| AudioMix | |
| AudioSource | Used when mapping <audio> |
| AudioSwitch | |
| Background | Used to map <backdrop> and <region> or <group> backgroundColor |
| Background2D | Used to map <background> and <region> or <group> backgroundColor |
| BAP | |
| BDP | |
| Billboard | Part of <transformation> and <group> |
| Bitmap | Used to map and <video> |
| Body | |
| BodyDefTable | |
| BodySegmentConnectionHint | |
| Box | Used to map <box> |
| Circle | Used to map <circle> |
| Collision | Part of <group> |
| Color | Used to map <lines>, <polygons> |
| ColorInterpolator | May be used by Animation module |
| CompositeTexture2D | |
| CompositeTexture3D | |
| Conditional | May be used by Animation module |
| Cone | Used to map <cone> |
| Coordinate | Used to map <points>, <lines>, <mesh> |
| Coordinate2D | Used to map <points>, <lines>, <polygons> |
| CoordinateInterpolator | May be used by Animation module |
| CoordinateInterpolator2D | May be used by Animation module |
| Curve2D | Used to map <curve> |
| Cylinder | Used to map <cylinder> |
| CylinderSensor | May be used by Animation module |
| DirectiveSound | |
| DiscSensor | May be used by Animation module |
| DirectionalLight | Used to map <light> |
| ElevationGrid | |
| Expression | |
| Extrusion | |
| Face | |
| FaceDefMesh | |
| FaceDefTables | |
| FaceDefTransform | |
| FAP | |
| FDP | |
| FIT | |
| Fog | Used to map <fog> |
| FontStyle | Used to map font styles for <string> |
| Form | |

| | |
|-------------------------|--|
| Group | Part of <transformation> and <group> |
| Hierarchical3DMesh | |
| ImageTexture | Used for and <texture> |
| IndexedFaceSet | Used to map <mesh> |
| IndexedFaceSet2D | Used to map <polygons> |
| IndexedLineSet | Used to map <lines> |
| IndexedLineSet2D | Used to map <lines> |
| Inline | Used to map <inline> |
| InputSensor | May be used for keyboard input (accessKey timing) |
| Layer2D | Used to map <region> and <group> when used with size attribute |
| Layer3D | Used to map <region> and <group> when used with size attribute |
| Layout | |
| LineProperties | Used to map <outline> |
| ListeningPoint | |
| LOD | |
| Material | Used to map <material> |
| Material2D | Used to map <material> |
| MaterialKey | Used to map <chromakey> |
| MatteTexture | May be used for mapping of some transition effects |
| MediaBuffer | May be used to map <prefetch> |
| MediaControl | May be used for time manipulations and interactively played media |
| MediaSensor | May be used for MediaClipMarker module mapping |
| MovieTexture | Used for <video> and <texture> |
| NavigationInfo | |
| Normal | Used to map <mesh> |
| NormalInterpolator | May be used by Animation module |
| OrderedGroup | Part of <transformation> and <group> |
| OrientationInterpolator | May be used by Animation module |
| PerceptualParameters | |
| PixelTexture | May be used to map |
| PlaneSensor | May be used by Animation module |
| PlaneSensor2D | May be used by Animation module |
| PointLight | Used to map <pointLight> |
| PointSet | Used to map <points> |
| PointSet2D | Used to map <points> |
| PositionInterpolator | May be used by Animation module |
| PositionInterpolator2D | May be used by Animation module |
| Proto | |
| ProximitySensor | May be used by Animation module (event source for animation) |
| ProximitySensor2D | May be used by Animation module (event source for animation) |
| QuantizationParameter | May be used to achieve higher compression for mapping |
| Rectangle | Used to map <rectangle> |
| ScalarInterpolator | May be used by Animation module |
| Script | May be used by Animation module for complex animations |
| Shape | Implicitly created when defining visual media elements |
| Sound | Used to map <audio> |
| Sound2D | Used to map <audio> |
| Sphere | Used to map <sphere> |
| SphereSensor | May be used by Animation module |
| SpotLight | Used to map <spotLight> |
| Switch | Part of <transformation> and <group> (used to map visibility attribute.) Also for <excl> |
| TermCap | May be used for some Content Control module functionality mapping |
| Text | Used to map <text>, <string> and <subtitles> |
| TemporalGroup | Used to map time containers and flexible time manipulations |
| TemporalTransform | Used to map time manipulations and flexible time manipulations |
| TextureCoordinate | Used to map <polygon> and <mesh> |
| TextureTransform | Used to map <texture> |
| TimeSensor | May be used by Animation module (event source for animation). And for timing |
| TouchSensor | May be used by Animation module (event source for animation) |
| Transform | Part of <transformation> and <group> |
| Transform2D | Part of <transformation> and <group> |

| | |
|------------------|--|
| Valuator | May be used by Animation module |
| ViewPoint | |
| Viseme | |
| VisibilitySensor | May be used by Animation module (event source for animation) |
| WorldInfo | Maps small part of RDF |

17 XMT-C Modules

17.1 MPEG-7

The MPEG-7 standard also known as "Multimedia Content Description Interface" aims at providing standardized core technologies allowing description of audiovisual data content in multimedia environments.

In order to achieve this broad goal, MPEG-7 standardizes:

- Descriptors (D): representations of Features, that define the syntax and the semantics of each feature representation,
- Description Schemes (DS), that specify the structure and semantics of the relationships between their components, which may be both Ds and DSs,
- A Description Definition Language (DDL), to allow the creation of new DSs and, possibly, Ds and to allows the extension and modification of existing DSs,
- System tools, to support multiplexing of description, synchronization issues, transmission mechanisms, file format, etc.

The following example illustrates the use of MPEG-7 descriptions within XMT. The example has been simplified for readability by removing necessary namespace qualifiers.

```

<seq begin=20s dur=10s>
  <img id="Image1" dur=5s>
    <StructuredAnnotation>
      <Who>Fernando Morientes</Who>
      <When>Spain Sweden soccer match</When>
      <TextAnnotation xml:lang='en-us'>
        This was the first goal of this match.
      </TextAnnotation>
    </StructuredAnnotation>
  </img>
  <img id="Image2" dur=2s>
    <Creation>
      <Creator>
        <role>presenter</role>
        <Individual>
          <GivenName>Ana</GivenName>
          <LastName>Blanco</LastName>
        </Individual>
      </Creator>
    </Creation>
  </img>
  <img id="Image3">
    <Histogram HistogramNormFactor="1000">
      <HistogramValues>400 100 200 150 150 </HistogramValues>
    </Histogram>
  </img>
</seq>
```

17.2 XMT-C Encoding, Delivery and Publication hints

One of the most important functionality XMT should provide is a giving a way of communication between the authoring entities and the bitstream generation entities. Since MPEG-4 scene will be composed of various media, number of encoders and bitstream generation tools will be involved to produce final bitstream. Therefore, bitstream generation entities including media encoders should be fully under the control of the authoring entities to generate the presentation as they wishes. Encoding Hints and Bitstream Generation Hints in this document will provide a way for the authoring entities to give their intent to the bitstream generation entities.

17.2.1 EncodingHints>

Encoding hints are composed of sourceFormat and targetFormat. sourceFormat will contain the information about the raw media should be encoded by the media encoders. The targetFormat will hint the attributes about the bitstream generated by the media encoders.

```
<EncodingHints>
  <sourceFormat>
    <param name="" value="" />
    <param name="" value="" />
    . . .
  </sourceFormat>
  <targetFormat>
    <param name="" value="" />
    <param name="" value="" />
    . . .
  </targetFormat>
<EncodingHints />
```

17.2.1.1 <sourceFormat>

The following common <param> name value pairs have been predefined to promote interchangeability of encoding hints. Other name value pairs may be used as required to qualify aspects of source format.

name="mimeType"

used to assist identification of media type for the source media. The value is the mimeType e.g
value="video/h263"

name="colorFormat"

used to specify color format of the visual media. The value is the colorFormat e.g value="YUV422". Other values are YUV420, YUV411, YUV9, YUV12, RGB24, RGB16, RGB32 etc

name="size"

used to specify the size of a visual source media, eg, value="w, h" where w,h is the width and height of the visual media.

name="length"

used to specify the length in time of a continuous source media, eg, value="10000.89ms". Units may be expressed in ms (milliseconds) or s (seconds)

name="cropSize"

used to select a rectangular section from a visual media stream, e.g a video or image. The value is area to include as the target media value="x, y, w, h" where x,y is a point relative to the top left corner of the visual media with a width and height. This may be used to crop a video during encoding. If no cropSize is specified the entire source visual is used.

name="cropLength"

used to specify a sub-section of a continuous source media, eg, value="1000ms, 2000.5ms". Units may be expressed in ms (milliseconds) or s (seconds) and are the beginning and end of the sub-section. If no cropLength is specified the entire source visual is used.

17.2.1.2 <targetFormat>

The following common <param> name value pairs have been predefined to promote interchangeability of encoding hints. Other name value pairs may be used as required to qualify aspects of target format.

name="size"

used to specify the size of the target visual media, eg, value="w, h" where w,h is the width and height of the visual media.

name="rateControl"

used to specify if rate control is used for the encoding process, eg. for video. value="off" or "on". Instead of "on" a particular form of rate control method can be specified if multiple mechanisms are supported, e.g. "TM5".

name="avgBitrate"

used to specify target average bit rate from the encoding process.

name="maxBitrate"

used to specify target maximum bit rate from the encoding process.

name="maxAUSize"

used to specify target maximum access unit size for the encoding process.

17.2.1.3 <BIFSEncodingHints>

The <BIFSEncodingHints> hints are provided principally to control the encoding process for BIFS to ensure that there can be a deterministic mapping for conformance purposes. In order to perform conformance tests for XMT-A the support of the <BIFSEncodingHints> is required and the encoding hint must be used by the encoding process wherever the BIFS provides a coding choice.

```
<BIFSEncodingHints
  SFNodeCoding    ="auto|mask|list"
  MFLListCoding   ="auto|list|vector"
  SFScriptCoding  ="auto|list|vector"
  ROUTESCoding    ="auto|list|vector"
/>
```

17.2.2 <DeliveryHints>

Delivery hints are to provide XMT with information that can be used to control or influence delivery of the MPEG-4 streams. Delivery hints are name value pairs in <param> element.

The following common <param> name value pairs have been predefined to promote interchangeability of encoding hints. Other name value pairs may be used as required to qualify aspects of source format.

name="carouselRate"

used to specify the rate of carousel insertions into BIFS and OD streams to provide random access points for multicast

name="carouselPercent"

used to specify the percent of total bandwidth to be used for carousel.

name="maxPacketSize"

maximum packet size for delivery (transport).

name="totalBandwidth"

total bandwidth of transport.

17.2.2.1 FlexMux

<MultiplexDescriptor>

```
<MultiplexDescriptor
  MuxID=""
  MuxType=""
  <MultiplexDescriptor/>
```

<FMCDescriptor>

```
< FMCDescriptor
  ES_ID=""
  FlexMuxChannel=""
  < FMCDescriptor/>
```

<MuxcodeDescriptor>

```
< MuxcodeDescriptor
  MuxCode =""
  version =""
  substructureCount =""
  < substructure>
    slotCount =""
    repetitionCount =""
    < slot>
      flexMuxChannel=""
      numberOfBytes =""
    < slot/>
    < slot>
      .....
      .....
    < slot/>
  < substructure/>
  < substructure>
  .....
  < substructure/>
< MuxcodeDescriptor/>
```

<FlexMuxTimingDescriptor>

```
< FlexMuxTimingDescriptor
  FCR_ES_ID=""
  FCRRResolution=""
  FRCLength="" # must be between 0 and 64
  FmxRateLength="" # must be between 1 and 32
< FlexMuxTimingDescriptor/>
```

<FlexMuxBufferDescriptor>

```
< FlexMuxBufferDescriptor
  FlexMuxChannel=""
  FB_BufferSize=""
< FlexMuxBufferDescriptor/>
```

<DefaultFlexMuxBufferDescriptor>

```
<DefaultFlexMuxBufferDescriptor
  FB_DefaultBufferSize=""
< DefaultFlexMuxBufferDescriptor/>
```

17.2.3 <PublicationHints>

Publication hints provide a mechanism to convert a generic authoring time placeholder for a stream into a specific reference for the media once it is deployed. When creating an mp4 file most streams will probably be referenced directly by Object Descriptor IDs with descriptors as necessary in the file. However if URLs are used then publication hint can be used to replace a generic placeholder by an actual url reference for when the content is created (encoded).

```
<PublicationHints>
  <param name="__pubhint1__"
        value="rtsp://www.somewhere.com/apath/bpath">
</PublicationHints>
```

In the above example the string “__pubhint1__” will be replaced by “rtsp://www.somewhere.com/apath/bpath” where it occurs in URI references.

17.3 XMT-C <authoring> Element

The <authoring> element provides a means to identify, at authoring time, additional information to facilitate authoring and exchange of information between authors and authoring tools. Authoring elements are defined for the following purposes:

1. specifying sets of elements to allow the grouping of objects into semantically coherent sets; these sets may be orthogonal to scene hierarchy.
2. adding properties to objects: these properties can be defined by the author

The <authoring> element contains one or more of the <metaSet> and <metaProperty> elements. The <authoring> element can be placed in any XMT element.

```
<authoring id=""
  scope="local" | "subtree"
/>
```

The scope attribute allows the semantics to be restricted to the element where the <authoring> is defined (local) or the element plus all its children. Using such rules an element may have inherited metaProperty's etc as well as ones that are defined inside that element. If an element would thus have multiple metaProperty's with the same name the one that is defined closest to the element (the closest in scope) shall be regarded as the correct value.

17.3.1 Specifying a <metaSet> of elements

```
<metaSet id="" description="" set="" />
```

This element defines a set. The description is intended to be used to identify the purpose of the set. All elements belonging to this set will use the attribute set="" to refer to their membership in one or more sets.

All XMT-A elements can contain the set="" attribute. The attribute may contain a list of ids when the element belongs to more than one set. Sets can be made up of any elements including nodes, and/or object descriptors etc. The <metaSet> element itself also contains the set attribute and hence sets of sets can be created.

A set is whatever an author and/or authoring tool deem relevant. Hence the definition of a set is up to the author and/or authoring tool alone. Certain sets may have meaning to a specific authoring tool and/or author. When files are exchanged from one authoring tool to another authoring tool, if the latter does not provide the same ‘higher-level’ support for the set(s) they should, in any case, be preserved by that tool. Hence if the file is edited again using the former tool the set will still be there (its relevance may have been altered however; e.g. if the set was a set of all red shapes and a new one was added by the latter tool the set would not have been updated to reflect that fact if the latter tool did not understand the higher meaning or the author did not ‘manually’ update the set – assuming the latter tool provided such a facility).

The following example shows a set defined by the author of related colors. An authoring tool may allow the author to vary the intensity or all related colors by the same amount. The example includes the second element belonging to two sets, the related colors set and also the thick Lines set.

```
<metaSet id="relatedColors" description="Colors of related objects" />

<Shape>
...
  <Material2D set="relatedColors" ...
<Shape DEF="SecondShape">
...
  <Material2D set="relatedColors, thickLines" ...
```

17.3.2 Specifying a <metaProperty>

```
<metaProperty id="" name="" value="" />
```

A metaProperty is an additional author and/or authoring tool defined property for any element. The element for which the extra property is being defined will contain this element.

The example shows a PositionInterpolator where two additional authoring properties have been defined

```
<PositionInterpolator ...>
  <authoring>
    <metaProperty name="movement" value="spiral"/>
    <metaProperty name="direction" value="clockwise"/>
  </authoring>
</PositionInterpolator>
"
```

In subclause 15.3.3 (Scene Graph Profiles), replace Table 59 with:

"

Table 59 – Scene Graph Profiles

| Scene Graph Tools | Scene Graph Profiles | | | | | | | | |
|--------------------------|-----------------------------|----------------------|--------------------|--------------------|------------------------|------------------------|--------------|---------------------|-----------------|
| | Basic 2D | Simple 2D | Core 2D | Main 2D | Advanced 2D | Complete 2D | Audio | 3D Audio | Complete |
| AcousticScene | | | | | | | | X | |
| AnimationStream | | | | | X | X | | X | X |
| Anchor | | | X | X | X | X | | X | X |
| AudioBuffer | | | | | X | X | X | X | X |
| AudioDelay | | | | | | X | X | X | X |
| AudioFX | | | | | | X | X | X | X |
| AudioMix | | | | | | X | X | X | X |
| AudioSwitch | | | | | X | X | X | X | X |
| Billboard | | | | | | | | X | X |
| ColorInterpolator | | | X | X | X | X | | | X |
| Collision | | | | | | | | | X |
| CompositeTexture2D | | | | | | X | | | X |
| CompositeTexture3D | | | | | | | | | X |
| Conditional | | | X | X | X | X | | X | X |
| CoordinateInterpolator2D | | | X | X | X | X | | | X |
| CoordinateInterpolator | | | | | | | | X | X |
| CylinderSensor | | | | | | | | | X |
| DirectiveSound | | | | | | | | X | |
| DiscSensor | | | | X | X | X | | | X |
| Form | | | | | | X | | | X |
| Group | | | | | X | X | X | X | X |
| Inline | | | X | X | X | X | | X | X |
| InputSensor | | | X | X | X | | | | |
| Layer2D | | | | X | X | X | | | X |
| Layer3D | | | | | | | | | X |
| Layout | | | | | | X | | | X |
| ListeningPoint | | | | | | X | | X | X |
| LOD | | | | | | | | X | X |
| MediaBuffer | | | | | X | | | | |
| MediaControl | | | X | X | X | | | | |
| MediaSensor | | | X | X | X | | | | |
| NormalInterpolator | | | | | | | | | X |
| NavigationInfo | | | | | | | | | X |
| OrderedGroup | X | X | X | X | X | X | | | X |
| OrientationInterpolator | | | | | | | | X | X |
| PerceptualParameters | | | | | | | | X | |
| PlaneSensor2D | | | | X | X | X | | | X |
| PlaneSensor | | | | | | | | | X |
| PositionInterpolator | | | | | | | | X | X |
| PositionInterpolator2D | | | X | X | X | X | | | X |
| ProximitySensor | | | | | | | | X | X |
| ProximitySensor2D | | | | X | X | X | | | X |
| QuantizationParameter | | | X | X | X | X | | X | X |
| ScalarInterpolator | | | X | X | X | X | | | X |
| Script | | | | | X | | | X | X |
| Sound | | | | | | | | X | X |
| Sound2D | X | X | X | X | X | X | X | X | X |
| ServerCommand | | | X | X | X | | | | |
| SphereSensor | | | | | | | | | X |

| | | | | | | | | | |
|---------------------|--|---|---|---|---|---|---|---|---|
| Switch | | | X | X | X | X | | X | X |
| TemporalTransform | | | | X | X | | | | |
| TemporalGroup | | | | X | X | | | | |
| TermCap | | | | | X | X | | X | X |
| TimeSensor | | | X | X | X | X | | X | X |
| TouchSensor | | | X | X | X | X | | X | X |
| Transform | | | | | | | | X | X |
| Transform2D | | X | X | X | X | | | | X |
| Valuator | | | X | X | X | X | | X | X |
| Viewpoint | | | | | | | | X | X |
| VisibilitySensor | | | | | | | | X | X |
| WorldInfo | | | | | X | X | | X | X |
| Node Update | | | X | X | X | X | | X | X |
| Route Update | | | X | X | X | X | | X | X |
| Scene Update | | X | X | X | X | X | X | X | X |
| ROUTE | | | X | X | X | X | | X | X |
| PROTO | | | | | X | | | | |
| PredictiveMF coding | | | | | X | | | | |

In subclause 15.3.3 (Scene Graph Profiles), replace Table 63 with :

Table 63 – Graphics Profiles

| Graphics Tools | Graphics Profiles | | | | | | |
|------------------|-------------------|------------------|---------|-------------|-------------|----------|----------|
| | Simple 2D | Simple 2D + Text | Core 2D | Advanced 2D | Complete 2D | 3D Audio | Complete |
| AcousticMaterial | | | | | | X | |
| Appearance | X | X | X | X | X | X | X |
| Background | | | | | | | X |
| Background2D | | X | X | X | X | | X |
| BAP | | | | | | | |
| BDP | | | | | | | |
| Bitmap | X | X | X | X | X | | X |
| Body | | | | | | | |
| BodyDefTable | | | | | | | |
| BodySegment | | | | | | | |
| ConnectionHint | | | | | | | |
| Box | | | | | | | X |
| Circle | | | X | X | X | | X |
| Color | | | X | X | X | | X |
| Cone | | | | | | | X |
| Coordinate | | | | | | X | X |
| Coordinate2D | | | X | X | X | | X |
| Curve2D | | | | X | X | | X |
| Cylinder | | | | | | | X |
| DirectionalLight | | | | | | | X |
| ElevationGrid | | | | | | | X |
| Expression | | | | | | | X |
| Extrusion | | | | | | | X |
| Face | | | | | | | X |
| FaceDefMesh | | | | | | | X |
| FaceDefTable | | | | | | | X |
| FaceDefTransform | | | | | | | X |
| FAP | | | | | | | X |
| FDP | | | | | | | X |

| | | | | | | | |
|-------------------|---|---|---|---|---|---|---|
| FIT | | | | | | | X |
| Fog | | | | | | | X |
| FontStyle | | X | X | X | X | | X |
| IndexedFaceSet | | | | | | X | X |
| IndexedFaceSet2D | | | X | X | X | | X |
| IndexedLineSet | | | | | | | X |
| IndexedLineSet2D | | | | X | X | | X |
| LineProperties | | | | X | X | | X |
| Material | | | | | | | X |
| Material2D | | X | X | X | X | | X |
| MaterialKey | | | | X | | | |
| MatteTexture | | | | X | | | |
| Normal | | | | | | X | X |
| PixelTexture | | | X | X | X | | X |
| PointLight | | | | | | | X |
| PointSet | | | | | | | X |
| PointSet2D | | | | | X | | X |
| Rectangle | | X | X | X | X | | X |
| Shape | X | X | X | X | X | X | X |
| Sphere | | | | | | | X |
| SpotLight | | | | | | | X |
| Text | | X | X | X | X | | X |
| TextureCoordinate | | | | X | X | | X |
| TextureTransform | | | | X | X | | X |
| Visme | | | | | | | X |

Add the following subclause as a new subclause of 15.3.4 (Scene Graph Profiles@Levels) after subclause 15.3.4.1.2 (Levels) and before subclause 15.2.4.2 (Levels for Simple 2D Scene Graph Profile):

15.3.4.2 Levels for the Basic 2D Scene graph Profile

15.3.4.2.1 Functionalities provided

The Basic 2D Scene Graph profile is designed for very simple scenes that may handle only few (possibly only 1) audio and visual elements. This profile includes basic 2D composition and audio and video nodes interfaces. The application area for the Basic 2D Scene Graph Profile is related to audio-video only scene description.

The only allowed BIFS nodes for audio objects is : {

The allowed BIFS nodes for visual objects are : {ImageTexture, MovieTexture}

15.3.4.2.2 Level 1

Level 1 of Basic 2D Scene Graph Profile is used to describe 1 audio and/or 1 visual object only.

The following restrictions apply for the Basic 2D Scene Graph Profile at Level 1 :

Table X – Restrictions for Basic 2D Scene Graph Profile at Level 1

| Nodes | Restrictions |
|--------------|---|
| AudioSource | addChildren, removeChildren, chidren, pitch, speed, numChan, phaseGroup not supported |
| ImageTexture | repeatS, repeatT not supported |
| MovieTexture | speed ignored (no rewind nor fast forward) repeatS, repeatT not supported |
| OrderedGroup | addChildren and removeChildren not supported 2 children maximum allowed only 1 OrderedGroup node per scene used as top node |
| Sound2D | intensity, spatialize, location not supported |

The usage of repeated OrderedGroup nodes to build bigger scenes is forbidden.

"

Add the following subclause as a new subclause of subclause 15.3.4.2 (Levels for Simple 2D Scene Graph Profile) after subclause 15.3.4.2.2 (Level 1) and before subclause 15.3.4.3 (Levels for Complete 2D Scene Graph Profile) :

"

15.3.4.2.3 Level 2

The following restrictions apply for the Simple 2D Graphics Profile at Level 2 :

Table X – Restrictions for Simple 2D Scene Graph Profile at Level 2

| Nodes | Restrictions |
|--------------|---|
| AudioClip | <i>pitch, description</i> not supported |
| AudioSource | <i>addChildren, removeChildren, chidren, pitch, speed, numChan, PhaseGroup</i> not supported |
| ImageTexture | <i>tepeatS, repeatT</i> not supported |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) <i>repeatS, repeatT</i> not supported |
| OrderedGroup | <i>addChildren and removeChildren</i> not supported <i>order</i> not supported 31 <i>children</i> maximum allowed |
| Scene Update | No restriction |
| Sound2D | <i>Intensity, spatialize, location</i> not supported |
| Transform2D | <i>addChildren and removeChildren</i> not supported <i>center, rotationAngle, ScaleOrientation</i> not supported (only translations and scalings are allowed) 31 <i>children</i> maximum allowed |

For Simple 2D Scene Graph Profile @ Level 2, the maximum number of nodes in a scene is limited to 64 including all instances of these nodes through DEF/USE mechanism.

"

Add the following subclauses as new subclauses of 15.3.4 (Scene Graph Profiles@Levels) after subclause 15.3.4.2.3 (Level 2) and before subclause 15.3.4.3 (Levels for Complete 2D Scene Graph Profile) :

"

15.3.4.3 Levels for the Core 2D Scene Graph Profile

15.3.4.3.1 Functionalities provided

The Core 2D Scene Graph profile includes basic 2D composition, 2D texturing, local interaction, local animation, BIFS updates, quantization, access to web links and sub-scenes, in addition to audio and visual elements. It also introduces tools such as back channel (*ServerCommand*) and VoD features (*MediaControl*, *MediaSensor*).

15.3.4.3.2 Level 1

The following restrictions apply for the Core 2D Scene Graph Profile at Level 1 :

Table X – Restrictions for Core 2D Scene Graph Profile at Level 1

| Nodes | Restrictions |
|--------------------------|---|
| Anchor | <i>addChildren and removeChildren</i> not supported 31 <i>children</i> maximum allowed |
| AudioClip | <i>pitch, description</i> ignored |
| AudioSource | <i>addChildren, removeChildren, chidren, pitch, speed, numChan, phaseGroup</i> not supported (no rewind nor fast forward) |
| ColorInterpolator | 255 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 31 coordinates per <i>keyValue</i> 255 key-value pairs |
| ImageTexture | <i>repeatS, repeatT</i> not supported |
| Inline | No restriction |

| | |
|------------------------|---|
| InputSensor | restriction to mice, keyboards, remote controls |
| MediaControl | <i>mediaSpeed</i> not supported (no rewind nor fast forward) 31 <i>url</i> maximum |
| MediaSensor | <i>Info</i> ignored |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) <i>repeatS</i> , <i>repeatT</i> not supported |
| Node Update | Add and remove commands for children fields are not allowed |
| OrderedGroup | <i>addChildren</i> and <i>removeChildren</i> not supported 31 <i>children</i> maximum allowed |
| PositionInterpolator2D | 255 key-value pairs |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 255 key-value pairs |
| Scene Update | No restriction |
| ServerCommand | No restriction |
| Sound2D | <i>Intensity</i> , <i>spatialize</i> , <i>location</i> not supported |
| Switch | No restriction |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | <i>addChildren</i> and <i>removeChildren</i> not supported. <i>center</i> , <i>rotationAngle</i> , <i>scaleOrientation</i> not supported (only translations and scalings are allowed) 31 <i>children</i> maximum allowed |
| Valuator | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Core 2D Scene Graph Profile @ Level 1 is 8,191 including all instances of these nodes through DEF/USE mechanism.

15.3.4.3.3 Level 2

The following restrictions apply for the Core 2D Scene Graph Profile at Level 2 :

Table X – Restrictions for Core 2D Scene Graph Profile at Level 2

| Nodes | Restrictions |
|--------------------------|---|
| Anchor | 127 <i>children</i> maximum allowed |
| AudioClip | <i>pitch</i> , <i>description</i> ignored |
| AudioSource | <i>addChildren</i> , <i>removeChildren</i> , <i>chidren</i> , <i>pitch</i> , <i>speed</i> , <i>numChan</i> , <i>phaseGroup</i> not supported (no rewind nor fast forward) |
| ColorInterpolator | 255 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 127 coordinates per <i>keyValue</i> 255 key-value pairs |
| ImageTexture | <i>repeatS</i> , <i>repeatT</i> not supported |
| Inline | No restriction |
| InputSensor | restriction to mice, keyboards, remote controls |
| MediaControl | <i>mediaSpeed</i> not supported (no rewind nor fast forward) 127 <i>url</i> maximum |
| MediaSensor | <i>info</i> ignored |
| MovieTexture | <i>speed</i> ignored <i>repeatS</i> , <i>repeatT</i> not supported |
| Node Update | No restriction |
| OrderedGroup | 127 <i>children</i> maximum allowed |
| PositionInterpolator2D | 255 key-value pairs |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 255 key-value pairs |
| Scene Update | No restriction |

| | |
|---------------|--|
| ServerCommand | No restriction |
| Sound2D | <i>intensity</i> , <i>spatialize</i> , <i>location</i> not supported |
| Switch | No restriction |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | <i>addChild</i> and <i>removeChild</i> not supported <i>center</i> , <i>rotationAngle</i> , <i>scaleOrientation</i> not supported (only translations and scaling are allowed) 127 <i>children</i> maximum allowed |
| Valuator | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Core 2D Scene Graph Profile @ Level 2 is 32,767 including all instances of these nodes through DEF/USE mechanism.

15.3.4.4 Levels for the Main 2D Scene Graph Profile

15.3.4.4.1 Functionalities provided

The Main2D Scene Graph profile includes basic 2D composition, 2D texturing, local interaction, local animation, BIFS updates, access to web links and sub-scenes, in addition to audio and visual elements. It also introduces tools such as back channel (*ServerCommand*), VoD features (*MediaControl*, *MediaSensor*) and Flextime nodes (*TemporalGroup*, *TemporalTransform*) for advanced, flexible synchronization.

15.3.4.4.2 Level 1

The following restrictions apply for the Main2D Scene Graph Profile at Level 1 :

Table X – Restrictions for Main2D Scene Graph Profile at Level 1

| Nodes | Restrictions |
|--------------------------|--|
| Anchor | <i>addChild</i> and <i>removeChild</i> not supported 31 <i>children</i> maximum allowed |
| AudioClip | <i>pitch</i> , <i>description</i> ignored |
| AudioSource | <i>addChild</i> , <i>removeChild</i> , <i>children</i> , <i>pitch</i> , <i>speed</i> , <i>numChan</i> , <i>phaseGroup</i> not supported (no rewind nor fast forward) |
| ColorInterpolator | 255 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 31 coordinates per <i>keyValue</i> 255 key-value pairs |
| DiscSensor | No restriction |
| Inline | Ignored |
| ImageTexture | <i>repeatS</i> , <i>repeatT</i> not supported; always treated as TRUE |
| InputSensor | restriction to mice, keyboards, remote controls |
| Layer2D | <i>addChild</i> and <i>removeChild</i> not supported 31 <i>children</i> maximum allowed |
| MediaControl | <i>mediaSpeed</i> not supported (no rewind nor fast forward) 31 <i>url</i> maximum |
| MediaSensor | <i>info</i> ignored |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) <i>repeatS</i> , <i>repeatT</i> not supported; always treated as TRUE |
| Node Update | No restriction |
| OrderedGroup | <i>addChild</i> and <i>removeChild</i> not supported 31 <i>children</i> maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 255 key-value pairs |
| ProximitySensor2D | No restriction |
| QuantizationParameter | Ignored |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 255 key-value pairs |
| Scene Update | No restriction |

| | |
|-------------------|--|
| ServerCommand | No restriction |
| Sound2D | <i>intensity</i> , <i>spatialize</i> , <i>location</i> not supported |
| Switch | 31 choices maximum allowed |
| TemporalGroup | <i>addChildren</i> and <i>removeChildren</i> not supported 7 children maximum allowed |
| TemporalTransform | <i>addChildren</i> and <i>removeChildren</i> not supported 31 children maximum allowed <i>speed</i> not supported <i>stretchMode</i> values linear and repeat not supported <i>shrinkMode</i> value linear not supported |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | <i>addChildren</i> and <i>removeChildren</i> not supported <i>center</i> , <i>rotationAngle</i> , <i>scaleOrientation</i> not supported (only translations and scalings are allowed) 31 children maximum allowed |
| Valuator | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Main2D Scene Graph Profile @ Level 1 is 8,191 including all instances of these nodes through DEF/USE mechanism.

Note: Where *addChildren* and *removeChildren* fields are not supported this refers only to in-scene routing. Node update is permitted to add and remove children from all MFNode fields.

15.3.4.4.3 Level 2

The following restrictions apply for the Main2D Scene Graph Profile at Level 2 :

Table X – Restrictions for Main2D Scene Graph Profile at Level 2

| Nodes | Restrictions |
|--------------------------|--|
| Anchor | <i>addChildren</i> and <i>removeChildren</i> not supported 255 children maximum allowed |
| AudioClip | <i>pitch</i> , <i>description</i> ignored |
| AudioSource | <i>addChildren</i> , <i>removeChildren</i> , <i>children</i> , <i>pitch</i> , <i>speed</i> , <i>numChan</i> , <i>phaseGroup</i> not supported (no rewind nor fast forward) |
| ColorInterpolator | 511 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 511 coordinates per <i>keyValue</i> 511 key-value pairs |
| DiscSensor | No restriction |
| Inline | No more than 4 nodes in the scene at any one time. Restricted to supporting content to that created with Simple or Basic Profile Scene Graph, and Simple2D Graphics (Simple2D+Text) |
| ImageTexture | <i>repeatS</i> , <i>repeatT</i> not supported; always treated as TRUE |
| InputSensor | restriction to mice, keyboards, remote controls |
| Layer2D | <i>addChildren</i> and <i>removeChildren</i> not supported 255 children maximum allowed |
| MediaControl | 255 <i>url</i> maximum speed adjustments supported but audio resampling is not required |
| MediaSensor | <i>info</i> ignored |
| MovieTexture | <i>speed</i> ignored <i>repeatS</i> , <i>repeatT</i> not supported; always treated as TRUE |
| Node Update | No restriction |
| OrderedGroup | <i>addChildren</i> and <i>removeChildren</i> not supported 255 children maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 1023 key-value pairs |
| ProximitySensor2D | No restriction |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |

| | |
|--------------------|--|
| ROUTE Update | No restriction |
| ScalarInterpolator | 1023 key-value pairs |
| Scene Update | No restriction |
| ServerCommand | No restriction |
| Sound2D | <i>Spatialize, location</i> not supported |
| Switch | 255 choices maximum allowed |
| TemporalGroup | <i>addChild</i> and <i>removeChild</i> not supported 15 children maximum allowed |
| TemporalTransform | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed speed adjustments supported but audio resampling is not required |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed |
| Valuator | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Main2D Scene Graph Profile @ Level 2 is 65,535 including all instances of these nodes through DEF/USE mechanism.

Note: Where *addChild* and *removeChild* fields are not supported this refers only to in-scene routing. Node update is permitted to add and remove children from all MFNode fields.

15.3.4.4.3 Level 3

The following restrictions apply for the Main2D Scene Graph Profile at Level 3 :

Table X – Restrictions for Main2D Scene Graph Profile at Level 3

| Nodes | Restrictions |
|--------------------------|--|
| Anchor | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed |
| AudioClip | <i>pitch, description</i> ignored |
| AudioSource | <i>addChild, removeChild, children, pitch, speed, numChan, phaseGroup</i> not supported |
| ColorInterpolator | 511 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 511 coordinates per <i>keyValue</i> 511 key-value pairs |
| DiscSensor | No restriction |
| Inline | Inlined content shall not exceed profiles of parent scene |
| ImageTexture | <i>repeatS, repeatT</i> not supported; always treated as TRUE |
| InputSensor | restriction to mice, keyboards, remote controls |
| Layer2D | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed |
| MediaControl | 255 <i>url</i> maximum speed adjustments supported but audio resampling is not required |
| MediaSensor | <i>info</i> ignored |
| MovieTexture | <i>speed</i> ignored <i>repeatS, repeatT</i> not supported; always treated as TRUE |
| Node Update | No restriction |
| OrderedGroup | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 1023 key-value pairs |
| ProximitySensor2D | No restriction |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 1023 key-value pairs |
| Scene Update | No restriction |

| | |
|-------------------|--|
| ServerCommand | No restriction |
| Sound2D | No restriction |
| Switch | 255 choices maximum allowed |
| TemporalGroup | <i>addChildren</i> and <i>removeChildren</i> not supported 15 children maximum allowed |
| TemporalTransform | <i>addChildren</i> and <i>removeChildren</i> not supported 255 children maximum allowed speed adjustments supported but audio resampling is not required |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | <i>addChildren</i> and <i>removeChildren</i> not supported 255 children maximum allowed |
| Valuator | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Main2D Scene Graph Profile @ Level 3 is 65,535 including all instances of these nodes through DEF/USE mechanism.

15.3.4.5 Levels for the Advanced 2D Scene Graph Profile

15.3.4.5.1 Functionalities provided

The Advanced 2D Scene Graph profile comprises all Basic 2D and Core 2D Scene Graph functionalities. The Advanced 2D Scene Graph profile allows in addition : advanced 2D composition, advanced local interaction, streamed animation (BIFS-Anim.), scripting, advanced audio, PROTO.

15.3.4.5.2 Level 1

The following restrictions apply for the Advanced 2D Scene Graph Profile at Level 1 :

Table X – Restrictions for Advanced 2D Scene Graph Profile at Level 1

| Nodes | Restrictions |
|--------------------------|--|
| Anchor | 511 <i>children</i> maximum allowed |
| AnimationStream | No restriction |
| AudioBuffer | No restriction |
| AudioClip | <i>pitch</i> not supported |
| AudioSource | 63 <i>children</i> maximum allowed <i>pitch</i> , <i>speed</i> , <i>numChan</i> , <i>phaseGroup</i> not supported (no rewind nor fast forward) |
| AudioSwitch | No restriction |
| ColorInterpolator | 1,023 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 128 coordinates per <i>keyValue</i> 1,023 key-value pairs |
| DiscSensor | No restriction |
| Group | 511 <i>children</i> maximum allowed |
| ImageTexture | No restriction |
| Inline | No restriction |
| InputSensor | No restriction |
| Layer2D | 511 <i>children</i> maximum allowed |
| MediaBuffer | No restriction |
| MediaControl | 63 <i>url</i> maximum speed adjustments supported but audio resampling is not required |
| MediaSensor | No restriction |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) |
| Node Update | No restriction |
| OrderedGroup | 511 <i>children</i> maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 1,023 key-value pairs |
| PredictiveMF coding | No restriction |
| PROTO | 31 fields |

| | |
|-----------------------|--|
| | 31 eventIns 31 eventOuts 31 exposedFields 7 levels |
| ProximitySensor2D | No restriction |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 1,023 key-value pairs |
| Scene Update | No restriction |
| Script | 31 eventIns 31 eventOuts 31 fields |
| ServerCommand | No restriction |
| Sound2D | <i>spatialize, location</i> not supported |
| Switch | No restriction |
| TemporalGroup | <i>addChild</i> and <i>removeChild</i> not supported 15 children maximum allowed |
| TemporalTransform | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed speed adjustments supported but audio resampling is not required |
| TermCap | No restriction |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | 511 <i>children</i> maximum allowed |
| Valuator | No restriction |
| WorldInfo | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Advanced 2D Scene Graph Profile @ Level 1 is 32,767 including all instances of these nodes through DEF/USE or PROTO mechanisms.

15.3.4.5.3 Level 2

The following restrictions apply for the Advanced 2D Scene Graph Profile at Level 2 :

Table X – Restrictions for Advanced 2D Scene Graph Profile at Level 2

| Nodes | Restrictions |
|--------------------------|---|
| Anchor | 16,383 <i>children</i> maximum allowed |
| AnimationStream | No restriction |
| AudioBuffer | No restriction |
| AudioClip | <i>pitch</i> not supported |
| AudioSource | 255 <i>children</i> maximum allowed <i>pitch, speed, numChan, phaseGroup</i> not supported (no rewind nor fast forward) |
| AudioSwitch | No restriction |
| ColorInterpolator | 16,383 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 1,023 coordinates per <i>keyValue</i> 16,383 key-value pairs |
| DiscSensor | No restriction |
| Group | 16,383 <i>children</i> maximum allowed |
| ImageTexture | No restriction |
| Inline | No restriction |
| InputSensor | No restriction |
| Layer2D | 16,383 <i>children</i> maximum allowed |
| MediaBuffer | No restriction |
| MediaControl | 63 <i>url</i> maximum speed adjustments supported but audio resampling is not required |
| MediaSensor | No restriction |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) |
| Node Update | No restriction |

| | |
|------------------------|--|
| OrderedGroup | 16,383 <i>children</i> maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 16,383 key-value pairs |
| PredictiveMF coding | No restriction |
| PROTO | 255 fields 255 eventInns 255 eventOuts 255 exposedFields 7 levels |
| ProximitySensor2D | No restriction |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 16,383 key-value pairs |
| Scene Update | No restriction |
| Script | 255 eventInns 255 eventOuts 255 fields |
| ServerCommand | No restriction |
| Sound2D | <i>spatialize, location</i> not supported |
| Switch | No restriction |
| TermCap | No restriction |
| TemporalGroup | <i>addChild</i> and <i>removeChild</i> not supported 15 children maximum allowed |
| TemporalTransform | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed speed adjustments supported but audio resampling is not required |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | 16,383 <i>children</i> maximum allowed |
| Valuator | No restriction |
| WorldInfo | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Advanced 2D Scene Graph Profile @ Level 2 is 131,071 including all instances of these nodes through DEF/USE or PROTO mechanism.

15.3.4.5.4 Level 3

The following restrictions apply for the Advanced 2D Scene Graph Profile at Level 3 :

Table X – Restrictions for Advanced 2D Scene Graph Profile at Level 3

| Nodes | Restrictions |
|--------------------------|---|
| Anchor | 16,383 <i>children</i> maximum allowed |
| AnimationStream | No restriction |
| AudioBuffer | No restriction |
| AudioClip | <i>pitch</i> not supported |
| AudioSource | 255 <i>children</i> maximum allowed <i>pitch, speed, numChan, phaseGroup</i> not supported |
| AudioSwitch | No restriction |
| ColorInterpolator | 16,383 key-value pairs |
| Conditional | No restriction |
| CoordinateInterpolator2D | 1,023 coordinates per <i>keyValue</i> 16,383 key-value pairs |
| DiscSensor | No restriction |
| Group | 16,383 <i>children</i> maximum allowed |
| ImageTexture | No restriction |
| Inline | No restriction |
| InputSensor | No restriction |
| Layer2D | 16,383 <i>children</i> maximum allowed |
| MediaBuffer | No restriction |

| | |
|------------------------|--|
| MediaControl | 63 <i>url</i> maximum |
| MediaSensor | No restriction |
| MovieTexture | <i>speed</i> ignored (no rewind nor fast forward) |
| Node Update | No restriction |
| OrderedGroup | 16,383 <i>children</i> maximum allowed |
| PlaneSensor2D | No restriction |
| PositionInterpolator2D | 16,383 key-value pairs |
| PredictiveMF coding | No restriction |
| PROTO | 255 fields 255 eventIns 255 eventOuts 255 exposedFields 7 levels |
| ProximitySensor2D | No restriction |
| QuantizationParameter | No restriction |
| ROUTE | No restriction |
| ROUTE Update | No restriction |
| ScalarInterpolator | 16,383 key-value pairs |
| Scene Update | No restriction |
| Script | 255 eventIns 255 eventOuts 255 fields |
| ServerCommand | No restriction |
| Sound2D | <i>spatialize</i> , <i>location</i> not supported |
| Switch | No restriction |
| TermCap | No restriction |
| TemporalGroup | <i>addChild</i> and <i>removeChild</i> not supported 15 children maximum allowed |
| TemporalTransform | <i>addChild</i> and <i>removeChild</i> not supported 255 children maximum allowed |
| TimeSensor | Ignored if <i>cycleInterval</i> < 0.03 second |
| TouchSensor | No restriction |
| Transform2D | 16,383 <i>children</i> maximum allowed |
| Valuator | No restriction |
| WorldInfo | No restriction |

The maximum number of nodes that is allowed in a scene compliant with the Advanced 2D Scene Graph Profile @ Level 3 is 131,071 including all instances of these nodes through DEF/USE or PROTO mechanism.

"

Replace the following subclause:

"

15.4.4.1.2 Levels

No levels are yet defined for the Simple 2D graphics profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

"

with

"

15.4.4.1.2 Level 1

The following restrictions apply for the Simple 2D Graphics Profile at Level 1 :

Table X – Restrictions for Simple 2D Graphics Profile at Level 1

| Nodes | Restrictions |
|------------|--|
| Appearance | <i>material</i> not supported <i>textureTransform</i> not supported |
| Bitmap | No restriction |
| Shape | No restriction |

Add the following subclauses as new subclauses of 15.4.4 (Graphics Profiles@Levels) after subclause 15.4.4.1.2 (Level 1) and before subclause 15.4.4.2 (Levels for Complete 2D Graphics Profile) :

"

15.4.4.2 Levels for the Simple 2D + Text Graphics Profile

15.4.4.2.1 Functionalities provided

The Simple 2D + Text Graphics profile is designed for applications where the only graphics to be used are text elements (possibly colored or transparent, and maybe in addition to audio and visual objects).

15.4.4.2.2 Level 1

The following restrictions apply for the Simple 2D + Text Graphics Profile at Level 1 :

Table X – Restrictions for Simple 2D + Text Graphics Profile at Level 1

| Nodes | Restrictions |
|--------------|---|
| Appearance | <i>textureTransform</i> not supported |
| Background2D | only 1 Background2D node allowed in a scene for color only background <i>url, set_bind</i> not supported |
| Bitmap | No restriction |
| FontStyle | No restriction |
| Material2D | <i>lineProps</i> not supported Used for colored and/or transparent text and transparent visual objects |
| Rectangle | No restriction |
| Shape | No restriction |
| Text | <i>maxExtent</i> not supported No texture mapping allowed 1,200 characters maximum in the scene at a time |

15.4.4.3 Levels for the Core 2D Graphics Profile

15.4.4.3.1 Functionalities provided

The Core 2D Graphics profile is designed for applications using some simple graphics elements (may be in addition to audio and visual objects).

15.4.4.3.2 Level 1

The following restrictions apply for the Core 2D Graphics Profile at Level 1 :

Table X – Restrictions for Core 2D Graphics Profile at Level 1

| Nodes | Restrictions |
|------------------|---|
| Appearance | <i>textureTransform</i> not supported |
| Background2D | only 1 Background2D node allowed in a scene for color and image background only <i>set_bind</i> not supported |
| Bitmap | No restriction |
| Circle | No texture mapping allowed |
| Color | No restriction (not used at this level) |
| Coordinate2D | 4 points maximum |
| FontStyle | No restriction |
| IndexedFaceSet2D | 15 <i>IndexedFaceSet2D</i> nodes maximum in a scene <i>set_colorIndex, set_coordIndex, set_texCoordIndex</i> not supported EventIns are ignored, the only field that can be modified is coord color not supported <i>colorIndex, colorPerVertex, texCoordIndex</i> not supported The number of points is restricted to be equal to 4 (quadrilateral) texCoord field is always considered to be (00 10 11 01) coordIndex field is always considered to be (0 1 2 3 -1) |

| | |
|--------------|---|
| | convex is always considered to be TRUE Face list shall be well-defined as follows : 1. Each face contains at least three non-coincident vertices 2. A given <i>coordIndex</i> is not repeated in a face 3. The vertices of a face shall define a planar polygon 4. The vertices of a face shall not define a self-intersecting polygon |
| Material2D | <i>lineProps</i> not supported |
| PixelTexture | 32x32 maximum image size 8 PixelTexture nodes maximum in a scene at a time |
| Rectangle | No restriction |
| Shape | No restriction |
| Text | <i>maxExtend</i> not supported No texture mapping allowed 6,480 characters maximum in the scene at a time |

15.4.4.3.2 Level 2

The following restrictions apply for the Core 2D Graphics Profile at Level 2 :

Table X – Restrictions for Core 2D Graphics Profile at Level 2

| Nodes | Restrictions |
|------------------|--|
| Appearance | <i>textureTransform</i> not supported |
| Background2D | only 1 Background2D node allowed in a scene for color and image background only <i>set_bind</i> not supported |
| Bitmap | No restriction |
| Circle | No texture mapping allowed |
| Color | 255 colors maximum in the scene at a time |
| Coordinate2D | 255 points maximum in the scene at a time |
| FontStyle | No restriction |
| IndexedFaceSet2D | 31 <i>IndexedFaceSet2D</i> nodes maximum in a scene <i>set_colorIndex</i> , <i>set_coordIndex</i> , <i>set_texCoordIndex</i> not supported EventIns are ignored <i>colorIndex</i> , <i>colorPerVertex</i> , <i>texCoordIndex</i> not supported convex is always considered to be TRUE 255 total indices maximum in all index fields in the scene Face list shall be well-defined as follows : 1. Each face is terminated with -1, including the last face in the array 2. Each face contains at least three non-coincident vertices 3. A given <i>coordIndex</i> is not repeated in a face 4. The vertices of a face shall define a planar polygon 5. The vertices of a face shall not define a self-intersecting polygon |
| Material2D | <i>lineProps</i> not supported |
| PixelTexture | 32x32 maximum image size 8 PixelTexture nodes maximum in a scene at a time |
| Rectangle | No restriction |
| Shape | No restriction |
| Text | <i>maxExtend</i> not supported No texture mapping allowed 6,480 characters maximum in the scene at a time |

15.4.4.4 Levels for the Advanced 2D Graphics Profile

15.4.4.4.1 Functionalities provided

The Advanced 2D Graphics profile is designed for applications using advanced graphics elements (possibly in addition to audio and visual objects).

15.4.4.4.2 Level 1

The following restrictions apply for the Advanced 2D Graphics Profile at Level 1 :

Table X – Restrictions for Advanced 2D Graphics Profile at Level 1

| Nodes | Restrictions |
|-------------------|--|
| Appearance | No restriction |
| Background2D | No restriction |
| Bitmap | No restriction |
| Circle | No restriction |
| Color | 65,535 colors maximum in the scene at a time |
| Coordinate2D | 65,535 points maximum in the scene at a time |
| Curve2D | 255 Curve2D nodes maximum in a scene 65,535 total elements in all type fields in the scene |
| FontStyle | No restriction |
| IndexedFaceSet2D | 255 IndexedFaceSet2D nodes maximum in a scene 65,535 total indices maximum in all index fields in the scene Face list shall be well-defined as follows : 1. Each face is terminated with -1, including the last face in the array 2. Each face contains at least three non-coincident vertices 3. A given coordIndex is not repeated in a face 4. The vertices of a face shall define a planar polygon 5. The vertices of a face shall not define a self-intersecting polygon |
| IndexedLineSet2D | 255 IndexedLineSet2D nodes maximum in a scene 65,535 total indices maximum in all index fields in the scene |
| LineProperties | No restriction |
| Material2D | No restriction |
| MaterialKey | No restriction |
| MatteTexture | Only one MatteTexture node allowed No BLUR function for s>2 Total pixel area of MatteTexture less than or equal to twice CIF |
| PixelTexture | 32x32 maximum image size 8 PixelTexture nodes maximum in a scene at a time |
| Rectangle | No restriction |
| Shape | No restriction |
| Text | 12,288 characters maximum in the scene at a time |
| TextureCoordinate | 65,535 coordinates maximum in the scene at a time |
| TextureTransform | No restriction |

15.4.4.4.3 Level 2

The following restrictions apply for the Advanced 2D Graphics Profile at Level 2 :

Table X – Restrictions for Advanced 2D Graphics Profile at Level 2

| Nodes | Restrictions |
|------------------|--|
| Appearance | No restriction |
| Background2D | No restriction |
| Bitmap | No restriction |
| Circle | No restriction |
| Color | 65,535 colors maximum in the scene at a time |
| Coordinate2D | 65,535 points maximum in the scene at a time |
| Curve2D | 32,767 Curve2D nodes maximum in a scene 1,048,575 total elements in all type fields in the scene |
| FontStyle | No restriction |
| IndexedFaceSet2D | 32,767 IndexedFaceSet2D nodes maximum in a scene 1,048,575 total indices maximum in all index fields in the scene |
| IndexedLineSet2D | 32,767 IndexedLineSet2D nodes maximum in a scene 1,048,575 total indices maximum in all index fields in the scene |
| LineProperties | No restriction |
| Material2D | No restriction |
| MaterialKey | No restriction |

| | |
|-------------------|---|
| MatteTexture | No BLUR function for s>2 Total pixel area of MatteTexture less than or equal to twice CCIR 601 |
| PixelTexture | 32x32 maximum image size 8 PixelTexture nodes maximum in a scene at a time |
| Rectangle | No restriction |
| Shape | No restriction |
| Text | 1,048,575 characters maximum in the scene at a time |
| TextureCoordinate | 65,535 coordinates maximum in the scene at a time |
| TextureTransform | No restriction |

"

In Annex H.6 (Node Coding Tables for new Group 4 nodes), add the following subclauses:

H.6.1 InputSensor

| InputSensor | SFWorldNode SF2DNode SF3DNode | 001 001 001 |
|-------------|-------------------------------------|-------------------|
| Field name | Field type | DEF id |
| enabled | SFBool | 00 |
| buffer | SFCommandBuffer | 01 |
| url | SFString | 10 |
| eventTime | SFTime | |
| | | 11 |

H.6.2 MatteTexture

| MatteTexture | SFWorldNode SF2DNode SF3DNode | 010 010 010 |
|--------------|-------------------------------------|-------------------|
| Field name | Field type | DEF id |
| surfaceA | SFTextureNode | 000 |
| surfaceB | SFTextureNode | 001 |
| alphaSurface | SFTextureNode | 010 |
| operation | SFString | 011 |
| overwrite | SFBool | 100 |
| fraction | SFFloat | 101 |
| parameter | MFFloat | 110 |
| | | 10 |
| | | 10 |

H.6.3 MediaBuffer

| MediaBuffer | SFWorldNode SF2DNode SF3DNode | 011 011 011 |
|----------------|-------------------------------------|-------------------|
| Field name | Field type | DEF id |
| bufferSize | SFFloat | 000 |
| url | MFURL | 001 |
| mediaStartTime | SFTime | 010 |
| mediaStopTime | SFTime | 011 |
| isBuffered | SFBool | |
| enabled | SFBool | 100 |
| | | 100 |
| | | 101 |

H.6.4 MediaControl

| MediaControl | SFWorldNode SF2DNode SF3DNode | 100 100 100 |
|----------------|-------------------------------------|-------------------|
| Field name | Field type | DEF id |
| url | MFURL | 000 |
| mediaStartTime | SFTime | 001 |
| mediaStopTime | SFTime | 010 |
| mediaSpeed | SFFloat | 011 |
| loop | SFBool | 100 |
| preRoll | SFBool | 101 |
| mute | SFBool | 110 |
| | | 110 |
| | | 0110 |

| | | | | | | | | |
|-------------|--------|-----|-----|------|--|--|--|--|
| enabled | SFBool | 111 | 111 | 0111 | | | | |
| isPreRolled | SFBool | | | 1000 | | | | |

H.6.5 MediaSensor

| | | | | | | | | |
|-----------------------|---|---------------|--------------|---------------|---------------|-------------------|----------|----------|
| MediaSensor | SFWorldNode SF2DNode SF3DNode | | | | | 101 101 101 | | |
| <i>Field name</i> | <i>Field type</i> | <i>DEF id</i> | <i>IN id</i> | <i>OUT id</i> | <i>DYN id</i> | <i>[m, M]</i> | <i>Q</i> | <i>A</i> |
| url | MFURL | | | 000 | | | | |
| mediaCurrentTime | SFTime | | | 001 | | | | |
| streamObjectStartTime | SFTime | | | 010 | | | | |
| mediaDuration | SFTime | | | 011 | | | | |
| isActive | SFBool | | | 100 | | | | |
| info | MFString | | | 101 | | | | |

"

Add the flowing subclause:

"

H.7 Node Definition Type Tables

H.7.1 SF2DNode

| SF2Dnode | | 5 Nodes | | | |
|------------------------------|-----|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| InputSensor | 001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MatteTexture | 010 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MediaBuffer | 011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| MediaControl | 100 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| MediaSensor | 101 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |

H.7.2 SF3DNode

| SF3Dnode | | 5 Nodes | | | |
|------------------------------|-----|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| InputSensor | 001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MatteTexture | 010 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MediaBuffer | 011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| MediaControl | 100 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| MediaSensor | 101 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |

H.7.3 SFWorldNode

| SFWorldNode | | 5 Nodes | | | |
|------------------------------|-----|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| InputSensor | 001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MatteTexture | 010 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| MediaBuffer | 011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| MediaControl | 100 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| MediaSensor | 101 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |

"

Add the following Annexes after Annex W:

"

Annex Z
(Normative)

XMT Schemas

The current schemas for XMT can be found in the separate file.

There are three parts to the XMT schema: XMT-A, XMT-O and XMT-C. The respective schemas can be found in the zip file in folders that are likewise named.

Annex AA
(Informative)

XMT/X3D Compatibility

The XMT-A representation follows the same rules as the compromise form of X3D and hence is compatible with it. MPEG-4 adds to this representation some extra attributes and elements for deterministic binary encoding and to augment authoring. However, these extra attributes and elements are optional.

An X3D document would go directly into a `<Scene>` element. MPEG-4 consists of a `<Header>` and a `<Body>` which contains the `<Replace><Scene>` BIFS command. This is because MPEG-4 can carry many media streams and can dynamically update the BIFS, and thus the MPEG-4 `<Scene>` element holds the MPEG-4 representation of all the BIFS, commands, OD framework etc. inside the `<Replace>` command.

The table below compares X3D and MPEG-4 representation to illustrate the high degree of compatibility and the small amount of change to go from X3D to MPEG-4 or vice versa (within the subset of elements that is contained in both standards of course).

| X3D | XMT-A |
|---|---|
| <pre><Header> <meta> </meta> </Header> <Scene> <!-- The scene contents --> </Scene></pre> | <pre><Header> <meta> </meta> <<u>InitialObjectDescriptor</u>> </Header> <Body> <<u>Replace</u>> <Scene> <!-- The scene contents --> </Scene> </Replace> </Body></pre> |

To fully convert the document from X3D to XMT-A, or vice versa, the outer `<X3D>` or `<XMT-A>` element with schema namespace reference will need to be altered accordingly,

Note: X3D <Scene> does not need to have a <Group> at the top level, while MPEG-4 requires a top-level node such as <Group>, <OrderedGroup>, <Layer2D> or <Layer3D> as the root of the scene graph. If the X3D scene does not have a single <Group> as the root it will be also be necessary to add this when converting to XMT-A. Note that X3D image, video and audio sources are referred directly by urls. While MPEG-4 can express the urls in an identical manner it is more likely that a conversion would create ObjectDescriptors for these media types and replace the source url references by ObjectDescriptor Ids.

Note: X3D allows commas as white space, using them as visual separators. XMT does not allow the use of commas as white space.

:
"

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Part 1: Systems

AMENDMENT 3: Intellectual Property
Management and Protection (IPMP)
extensions

*Technologies de l'information — Codage des objets audiovisuels —
Partie 1: Systèmes*

*AMENDEMENT 3: Gestion et extensions de protection de la propriété
intellectuelle (IPMP)*

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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.

Amendment 3 to ISO/IEC 14496-1:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Introduction

This document specifies IPMP extensions to the currently specified IPMP specification (the “Hooks”), documented in ISO/IEC 14496-1:2001.

“Hooks” Terminals do not support the additional functionality specified here. Hence, “Hooks” Terminals will not be able to fully process “Extensions” content. However, the syntax and semantics here are compliant with the “Hooks” framework, and therefore allow for graceful failure of a well-designed Terminals in either the event that they are compliant to non-extended IPMP only and receive extended IPMP conforming content, that they are compliant to extended IPMP as outlined in this document and able to process either non-extended conforming content or extended conforming content to the extent that their implementations allow.

Additionally, although this amendment does not preclude the use of “Hooks” and “Extensions” tools being used in the same MPEG-4 presentation, the behaviour of both “Hooks” as well as “Extensions” being used for the protection of the same stream is undefined.

This Amendment specifies

- Extensions to the OD framework in a backward compatible manner to support the use of IPMP in the protection of OD and scene description streams.
- Extensions to the OD framework to support the Identification of required IPMP tools using either 128 bit registered Ids or parametric descriptions.
- Extensions to `IPMP_DescriptorPointer` in a backward compatible manner to support the extended addressing of IPMP streams.
- Extensions to `IPMP_Descriptor` in a backward compatible manner to support the use of 16 bit identifiers as well as supporting the identification of the location within a given stream where the specified IPMP tool is to be placed as well as supporting the sequencing of multiple tools at the same location.
- Extensions to `IPMP_Descriptor` in a backward compatible manner to support the carriage of normative IPMP information.
- Extensions to `IPMP_Message` in a backward compatible manner to support the specific addressing of a given `IPMP_Message` to specific IPMP tools.
- Extensions to `IPMP_Message` in a backward compatible manner to support the carriage of normative IPMP information.
- The definition, as well as Extension tags, syntax and semantics for an `IPMP_Data_BaseClass` to support the following functionalities.
 - ◊ Mutual Authentication for IPMP tool to IPMP tool as well as IPMP tool to Terminal communication.
 - ◊ The requesting by IPMP tools of the connection/disconnection to requested IPMP tools.
 - ◊ The notification to IPMP tools of the connection/disconnection of IPMP tools.
 - ◊ Common IPMP processing.
 - ◊ IPMP tool to/from User interaction.

- Syntax and semantics for the carriage of IPMP tools in the bit stream.
- Syntax and semantics for IPMP information carriage to and from IPMP tools.
- Syntax and semantics for the requesting and transfer of content and IPMP Tools between Terminals as well as extension tags, syntax and semantics to the IPMP_Data_BaseClass ISO/IEC 14496-1 used therein.
- XML syntax and semantics for the description of the environment in which an MPEG-4 Terminal/application is operating.
- A list of registration authorities required for the support of the amended specifications found herein.

Information technology — Coding of audio-visual objects —

Part 1: Systems

AMENDMENT 3: Intellectual Property Management and Protection (IPMP) extensions

In Clause 0.6.1.1, replace the text:

"The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems. The IPMP interface consists of IPMP elementary streams and IPMP descriptors. IPMP descriptors are carried as part of an object descriptor stream. IPMP elementary streams carry time variant IPMP information that can be associated to multiple object descriptors. The IPMP System itself is a non-normative component that provides intellectual property management and protection functions for the terminal. The IPMP System uses the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. An application may choose not to use an IPMP System, thereby offering no management and protection features."

with:

"The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems in the form of monolithic IPMP Systems or modular IPMP Tools. The IPMP interface consists of IPMP elementary streams and IPMP descriptors. IPMP descriptors are carried as part of an object descriptor stream. IPMP elementary streams carry time variant IPMP information that can be associated to multiple object descriptors. The IPMP System, or IPMP Tools themselves are non-normative components that provides intellectual property management and protection functions for the terminal. The IPMP Systems or Tools uses the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. An application may choose not to use an IPMP System, thereby offering no management and protection features."

In Clause 4.38, replace the text:

"Only the interface to such systems is normatively defined."

with the text:

"The interface to such systems is defined as well as :

- The provision for the identification of IPMP Tools either through the use of a registration authority or through the use of a functional description of the IPMP Tools' capabilities in a parametric fashion.
- Controlling the time of instantiation of IPMP Tools either by the inclusion of references to the required IPMP Tools or at the request of already instantiated IPMP Tools.

- Providing secure messaging between IPMP Tools and the Terminal and between IPMP Tools and the User.
- Notification of the instantiation of IPMP Tools to IPMP Tools requesting such notification.
- Interaction between IPMP Tools, and/or the Terminal and the User.
- The carriage of IPMP Tools within the bitstream.”

In Clause 4, insert the following text alphabetically:

Binary Representation

In the context of an IPMP Tool, this is the format of the implementation of that IPMP Tool, Examples: Platform Dependent Native Code, Java™ bytecode.

Content

This implies part or whole of an MPEG presentation.

Content Consumption

Any experience of given Content implies consumption of that content. Access, Playback, Denial of Access and Creation of a Copy are all types of content consumption.

Content Stream

This is the incoming content, of MPEG-4 format.

Control Point

A point on a given elementary stream in a Terminal where IPMP Processing on stream data shall be carried out.

IPMP Device

An implemented application that implements an MPEG-4 Terminal supporting the use of MPEG-4 IPMP.

IPMP Information

Information directed to a given IPMP Tool to enable, assist or facilitate its operation.

IPMP System

A monolithic IPMP protection scheme which requires implementation dependant access to protected streams at required Control Points and must provide any intra-communication within an IPMP System on an implementation basis.

IPMP Tool

IPMP tools are modules that perform (one or more) IPMP functions such as authentication, decryption, watermarking, etc. Conceptually the use of one or more IPMP Tools is combined to perform the functionality of an IPMP System. IPMP Tools, as opposed to IPMP Systems, are normatively identified as to which control points they function at as well as are provided normative methods for secure communications both within as well as outside of a given IPMP Tools comprised functional “IPMP System”. An additional difference between IPMP Tools and IPMP Systems is that IPMP Tools, or a combination thereof, may be used for the protection of Object streams.

In this amendment the use of the term “IPMP System” is used in some cases to indicate either an actual IPMP System or a combination of IPMP Tools whose combination provides the functionality of an IPMP System. In cases where the distinction is important the proper respective terms are used.

IPMP Tool Identifier

This refers to the IPMP Tool ID. It identifies a Tool in an unambiguous way, at the presentation level or at a universal level. Two different identifiers are provided to support the differentiation between the use of IPMP Systems and IPMP Tools.

IPMP Tool List

The IPMP Tool List identifies, and enables selection of, the IPMP Tools required to process the Content.

IPMP Tool Manager

The IPMP Tool Manager is a conceptual entity within the Terminal that processes IPMP Tool List(s) and retrieves the Tools that are specified therein.

IPMP Tool Message

A message passed between any combination of IPMP Tool or Terminal.

IPMP Tool Stream

An elementary stream carrying an implementation of an IPMP Tool.

Message Router

A conceptual entity within the Terminal that implements the Terminal-side behavior of the Terminal-Tool interface.

Mutual Authentication

Protocols carried out to determine the proper and correct identity of a communicating entity and to secure the communication channels between communicating entities.

Parametric Configuration

Information that carries task-specific parameter specification in an extensible form.

Parametric Description

Parametrically described tools shall be defined by an SDL declaration that governs a given description, the parametric configuration and other interface message(s) that drive the tool and the behaviour defined for fulfilment of such a description.

Representation Format

The binary format, platform and communication mechanisms applicable to a given implementation of an IPMP Tool or Terminal.

Scope of Protection

Scope of protection refers to the elementary stream and/or object governed by a given IPMP Tool instance.

Terminal

A Terminal is an environment that consumes possibly protected Content in compliance with the usage rules.

User

A hardware, software or human entity that is the initiator and/or target of content consumption.

In Subclause 8.2.1, replace Table 1 with the following:

Table 1 - List of Class Tags for Descriptors

| Tag value | Tag name |
|-----------|---------------------------------------|
| 0x00 | Forbidden |
| 0x01 | ObjectDescrTag |
| 0x02 | InitialObjectDescrTag |
| 0x03 | ES_DescrTag |
| 0x04 | DecoderConfigDescrTag |
| 0x05 | DecSpecificInfoTag |
| 0x06 | SLConfigDescrTag |
| 0x07 | ContentIdentDescrTag |
| 0x08 | SupplContentIdentDescrTag |
| 0x09 | IPI_DescrPointerTag |
| 0x0A | IPMP_DescrPointerTag |
| 0x0B | IPMP_DescrTag |
| 0x0C | QoS_DescrTag |
| 0x0D | RegistrationDescrTag |
| 0x0E | ES_ID_IncTag |
| 0x0F | ES_ID_RefTag |
| 0x10 | MP4_IOD_Tag |
| 0x11 | MP4_OD_Tag |
| 0x12 | IPL_DescrPointerRefTag |
| 0x13 | ExtendedProfileLevelDescrTag |
| 0x14 | profileLevelIndicationIndexDescrTag |
| 0x15-0x3F | Reserved for ISO use |
| 0x40 | ContentClassificationDescrTag |
| 0x41 | KeyWordDescrTag |
| 0x42 | RatingDescrTag |
| 0x43 | LanguageDescrTag |
| 0x44 | ShortTextualDescrTag |
| 0x45 | ExpandedTextualDescrTag |
| 0x46 | ContentCreatorNameDescrTag |
| 0x47 | ContentCreationDateDescrTag |
| 0x48 | OCICreatorNameDescrTag |
| 0x49 | OCICreationDateDescrTag |
| 0x4A | SmpteCameraPositionDescrTag |
| 0x4B-0x5F | Reserved for ISO use (OCI extensions) |
| 0x60 | IPMP_ToolsListDescrTag |
| 0x61 | IPMP_ToolTag |
| 0x62-0xBF | Reserved for ISO use |
| 0xC0-0xFE | User private |
| 0xFF | Forbidden |

In Clause 8.3, replace the title:

Intellectual Property Management and Protection (IPMP)

with:

Intellectual Property Management and Protection framework (IPMP)

In Subclause 8.3.1, replace the entire text with:

The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems or IPMP Tools. Additionally, the framework contains a secure messaging system usable between IPMP Tools as well as IPMP Tools and the Terminal and IPMP Tools and the User.

An IPMP System or IPMP Tools are non-normative components that provide intellectual property management and protection functions for the terminal.

The IPMP interface consists of IPMP elementary streams and IPMP descriptors. The normative structure of IPMP elementary streams is specified in this Subclause. IPMP descriptors are carried as part of an object descriptor stream and are specified in 8.6.14. The IPMP interface allows applications (or derivative application standards) to build specialized IPMP Systems or IPMP Tools. Alternatively, an application may choose not to use an IPMP System or IPMP Tools, thereby offering no management and protection features. The IPMP System and IPMP Tools use the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. The detailed semantics and decoding process of the IPMP System or IPMP Tools are not in the scope of ISO/IEC 14496. The usage of the IPMP System/Tools Interface, however, is explained in 8.8, where the usage of the IPMP framework is also explained.

8.3.1.1 IPMP Architecture overview

This clause describes the general IPMP architecture. For detailed IPMP architecture linked to MPEG-4 system, please refer to 8.8.6.

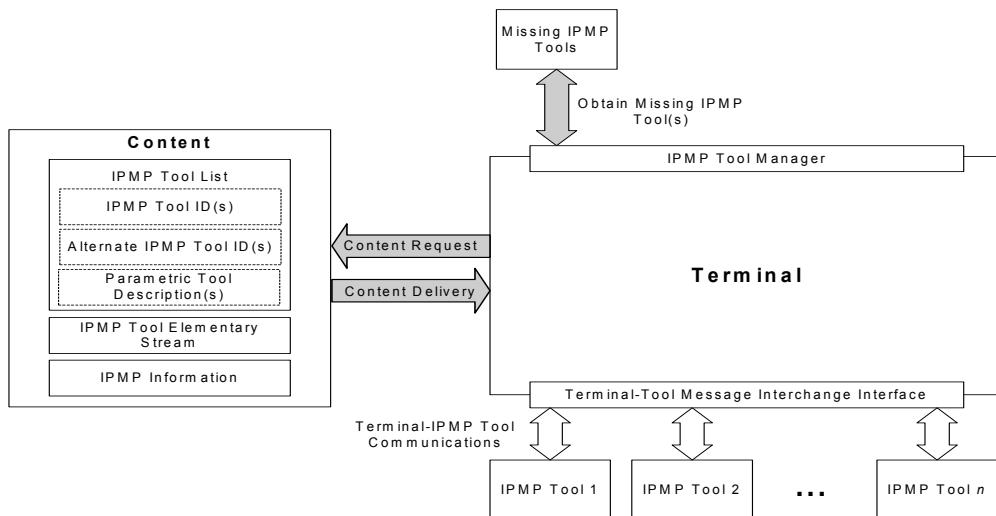


Figure AMD3-1 — Architecture Diagram for General Concepts

8.3.1.1.1 Messaging

To facilitate the cooperation of multiple tools in the protection and governance of content, a message based architecture is provided. The message based architecture has three advantages over functional interface type architectures. The first is that security can more easily be maintained as messages are less difficult to protect in an open framework than parameters in a function parameters list. The second is that the only entities that need be concerned with a given message's definition are those that need to generate or act upon a given message and so additional functionality can be created and supported simply through the addition of required messages. The third is that full interoperability with IPMP tools can be easily achieved by using the `IPMP_ToolAPI_Config` [8.3.2.12.5] carried in IPMP Descriptor, or by defining a single messaging API by a third-party forum who adopts IPMP.

Physical routing of information and context resolution are handled by a conceptual entity called the Message Router. The Message Router abstracts all platform-dependent routing and delivery issues, from the IPMP Tools. The interface between the Message Router and the Tools, is non-normative and is not defined in this specification, however, the information on the messaging interface can be carried in `IPMP_ToolAPI_Config` to assist interoperability.

All IPMP Tool interactions take place via the Terminal. IPMP Tools do not communicate directly with each other within the scope of this standard.

The delivery of both bit stream sourced IPMP information as well as IPMP tool and Terminal generated information is supported through the use of three separate messages which are passed via the Message Router to IPMP tools. The three messages are, `IPMP_MessageFromBitstream` [8.3.2.12.2], which is used to deliver IPMP stream data, `IPMP_DescriptorFromBitstream` [8.3.2.12.3], which is used to deliver IPMP Descriptors [ISO/IEC 14496-1] and `IPMP_MessageFromTool` [8.3.2.12.4], which is used to deliver messages from either other IPMP tools or the Terminal itself.

In these extensions, a core set of messages are provided which cover what are identified as core functional requirements.

8.3.1.1.2 Mutual Authentication

The most important aspect of a secure messaging architecture is the use of cryptographic algorithms and protocols that allow one to perform a number of important security functions.

At any point in IPMP Information or Content processing, IPMP Tools may be required to communicate with one another or the Terminal. The degree of security required for such communication is determined by a number of variables including information that may be included by the content provider in the Content and conditions of trust established between tool providers a priori and out of band. It is generally the case that a given ES is protected by multiple tools but that certain types of tools are complex (e.g. Rights Management tools) and others are utilities (e.g. Decryption engines). Complex tools may control the instantiation of other tools or make decisions about content use in response to usage queries from the terminal. Mutual authentication may occur between any pair of tools but the level of security required for this communication will in part be dictated by data contained in the bitstream in an opaque manner. The mechanism for making the determination of this security level is non-normative.

Mutual authentication is executed as follows:

1. The Tool that initiates mutual authentication with another tool determines the conditions of trust to be achieved by such authentication, i.e. the initiating tool determines whether it needs integrity protected communication or full secure, authenticated communication. This level may or may not be dictated by IPMP Information in the Content.
2. The communicating tools then engage in a message exchange to determine which authentication protocol will be used. In some cases, this protocol will have been determined by an a priori out of band negotiation between the tool providers in their security audits of one another.

These extensions provide a set of messages to support the identified functionalities. The first message `IPMP_InitAuthentication` [8.3.2.7.1] may be used and delivered to a given IPMP tool such that the receiving IPMP tool is informed as to its required communication partner as well as security measures that must be in place. Following this message or the absence thereof, IPMP tools required to do so will use the `IPMP_MutualAuthentication` [8.3.2.7.2] message as required to determine or create secure channels of communication as needed based on the application.

As one purpose of Mutual Authentication is the verification of trust relationships existing between two entities these specifications provide for the carriage of trust and security metadata. This metadata may include zero or more certificates, credentials or integrity verification information. The creation or establishment of trust relationships are established by out of band relationships between the different entities involved in protecting and managing the content. However, the trust metadata that results from such relationships needs to be made available to permit static and dynamic verification of trust.

During the Mutual Authentication process the carriage of `IPMP_TrustSecurityMetadata` [8.3.2.7.2.7] is supported to provide additional security related data usable by IPMP tools to determine trust related information.

Once Mutual Authentication is performed, the `IPMP_SecureContainer` [8.3.2.7.3] may be used to pass information securely between IPMP tools and IPMP tools and Terminal.

8.3.1.1.3 IPMP tool acquisition

ISO/IEC 14496-1 defines `IPMP_ToolListDescriptor` [8.6.14.2] which conveys the list of IPMP tools required to access the content associated with the `InitialObjectDescriptor` in which it is described, and may include a list of alternate IPMP tools or parametric descriptions of tools required to access the content. The conceptual entity Tool Manager parses the tool list, makes sure all tools are available, and retrieves missing tools if any.

If a given required tool is not present on a given Terminal, the `IPMPToolES_DecoderConfig` [8.3.2.8.3] descriptor can be used to indicate an IPMP tool bearing stream with `IPMP_Tools_ES_AU` [8.3.2.8.4] being used to actually carry the required tool.

A missing IPMP Tool can also be acquired from a neighbouring IPMP device via tool transfer messages defined in Annex D, or it can be acquired by connecting to a remote server and providing the terminal description as defined in Annex E.

8.3.1.1.4 IPMP Tool connection and disconnection

In the IPMP architecture, IPMP tool may be connected as the result of an `IPMP_DescriptorPointer` [ISO/IEC 14496-1] being processed and in addition may be connected due to requests from already connected IPMP tools. Note: Instantiation of the Tools to be connected is implementation dependent, however, the information on how to instantiate the Tools can be carried in `IPMP_ToolAPI_Config` [8.3.2.12.5] to assist interoperability.

IPMP tools may use the `IPMP_GetTools` [8.3.2.8.1] and `IPMP_GetToolsResponse` [8.3.2.8.2] messages to request a list of tools available for connection that exist as well as a response to the request, respectively.

IPMP tools as well as the Terminal may also query a given IPMP tool as to its capabilities and functionality by using the `IPMP_ToolParamCapabilitiesQuery` [8.3.2.8.5] message with the tool being queried using the `IPMP_ToolParamCapabilitiesResponse` [8.3.2.8.6] message as a reply.

Knowing that a given tool is needed for processing, an IPMP tool may request the connection of another IPMP tool by using the `IPMP_ConnectTool` [8.3.2.8.7] message and may request the disconnection of another IPMP tool by using the `IPMP_DisconnectTool` [8.3.2.8.8] message. A connection may require the actual instantiation of a tool or may be accomplished through physical/electronic means.

The `IPMP_ConnectTool` message contains control point and sequence information to determine the exact location to connect the requested tool. Tools connected at the request of other tools inherit the same scope of protection as the requesting tool. Note that some control points are not associated with any known point on an Elementary Stream. Note also that there are issues with scoping and scenarios that are somewhat illogical, especially as related to BIFS nodes referencing ODs.

Each instantiation of an IPMP Tool shall establish a new logical instance of the tool, for a particular scope of protection. The Terminal assigns a context identifier for the logical instance of the tool, which maps to the specific tool instance, and therefore to the associated scope of protection. These context identifiers shall be unique to ensure unambiguous message addressing.

The process of instantiation involves the following steps

1. Establish a context for the Tool being instantiated
2. Establish a link between the MR and the Tool instance
3. Establish a link between the Tool instance and the MR.

Details of this process are implementation specific. The normative result is a context/address being made available for communication and use of the instantiated tool by other tools as well as the Terminal.

The tool requesting connection shall receive an `IPMP_NotifyToolEvent` [8.3.2.9.3] message indicating the instantiation of the IPMP Tool, and its associated context. The requesting tool and the instantiated tool may perform mutual authentication thereafter.

If an IPMP tool knows of another tool with which it must communicate has already been connected, it may use the `IPMP_GetToolContext` [8.3.2.8.9] message and will receive an `IPMP_GetToolContextResponse` [8.3.2.8.10] message in reply if the requested IPMP tool is already connected with the message containing the address through which the requesting tool may use to communicate with the requested tool.

8.3.1.1.5 Notification of IPMP Tool connection and disconnection

During the processing of IPMP protected content, a number of IPMP tools may be involved, for communication and various security purposes, notification messages are supplied to notify IPMP tools when other IPMP tools have either been connected, disconnected or processed watermark information. Additionally IPMP tools may request at any time a list of all the IPMP tools currently connected at various specifiable scopes of protection.

The `IPMP_AddToolNotificationListener` [8.3.2.9.1] message may be used to indicate the sending IPMP tools intent to receive notifications of events and scopes of protection as specified in the `IPMP_AddToolNotificationListener` message. To remove one's self from being notified in the future for specified events, an IPMP tool may use the `IPMP_RemoveToolNotificationListener` [8.3.2.9.2] to do so.

As events occur for which notifications have been requested, the `IPMP_NotifyToolEvent` [8.3.2.9.3] message is sent to requesting IPMP tools.

8.3.1.1.6 Common IPMP processing

Direct support has been provided for the carrying out of common IPMP processing operations. Specific support and the related messages are as follows:

- `IPMP_CanProcess` [8.3.2.10.1] for the notification by an IPMP tool to the Terminal that stream processing may begin. All tools connected and processing data within a given stream must send permission before any tools in the stream receive stream data.
- `IPMP_Opaquedata` [8.3.2.10.2] for the carriage of user defined data.
- `IPMP_KeyData` [8.3.2.10.3] for the carriage of decryption key data as well as timing information to determine the validity period of time varying keys.
- `IPMP_RightsData` [8.3.2.10.4] for the carriage of rights expressions.
- `IPMP_SelectiveDecryptionInit` [**Error! Reference source not found.**] for the configuration of a decryption tool.
- `IPMP_AudioWatermarkingInit` [**Error! Reference source not found.**] for the configuration of an audio watermarking tool.
- `IPMP_SendAudioWatermark` [**Error! Reference source not found.**] for the sending of information to be embedded or that was extracted.
- `IPMP_VideoWatermarkingInit` [**Error! Reference source not found.**] for the configuration of a video watermarking tool.
- `IPMP_SendVideoWatermark` [**Error! Reference source not found.**] for the sending of information to be embedded or that was extracted.

8.3.1.1.7 IPMP tool to/from User interaction

During IPMP processing, direct interaction between IPMP tools and a User may be required. The `IPMP_UserQuery` [8.3.2.11.1] message is used to provide information to be relayed to a User and to request information as well. The `IPMP_UserQueryResponse` [8.3.2.11.2] is used to relay information provided by a User back to the originator of the User query.”

In Subclause 8.3.2.5.1, replace the syntax with the following:

```
aligned(8) expandable(228-1) class IPMP_Message
{
    bit(16) IPMPS_Type;
    if (IPMPS_Type == 0)
    (
        bit(8) URLString[sizeOfInstance-2];
    )
}
```

```

else (if (IPMPS_Type == 0xFFFF)
{
    bit(16) IPMP_DescriptorIDEx;
    IPMP_Data_BaseClass IPMP_ExtendedData[]
} else {
    bit(8) IPMP_data[sizeOfInstance-2];
}
}

```

In Subclause 8.3.2.5.2, replace the semantics with the following:

The `IPMP_Message` conveys time-varying IPMP information for associated IPMP Tool instances.

`IPMPS_Type` – The type of the IPMP System, in “Hooks” compliant Terminals as specified in ISO/IEC 14496-1:2001. The values “0x0002” to “0x2000” are reserved for future ISO use. A Registration Authority, as designated by ISO/IEC JTC 1, shall assign a unique valid value for this field for a specific IPMP System Type. If the `IPMP_DescriptorID` is “0”, another URL is referenced. This process continues until an `IPMP_Message` with a non-zero `IPMP_DescriptorID` is accessed.

`URLString[]` - contains a UTF-8 [6] encoded URL that shall point to the location of a remote `IPMP_Message`.

`IPMP_DescriptorID` – this is one of the `IPMP_DescriptorIDs` in the scope of service of this IPMP Stream and identifies the recipient(s) of the `IPMP_Message`.

`IPMP_ExtendedData` - The IPMP data that is extended from `IPMP_Data_BaseClass` to be delivered to the IPMP tool.

`IPMP_data` - opaque data to be delivered to the IPMP Tool.

The `IPMP_Message` is backward compatible with the `IPMP_Message` of ISO/IEC 14496-1: 2001. However, in order to unambiguously identify the version of the IPMP stream, the `ObjectTypeIndication` shall be set to “0x02” for streams complying with this part of the specification. IPMP Streams complying with ISO/IEC 14496-1:2001 shall use an `ObjectTypeIndication` of “0xFF” as specified for in 8.6.6.2.

Insert the following after Subclause 8.3.2.5.2:

8.3.2.6 Extension tags for the `IPMP_Data_BaseClass`

`IPMP_Data_BaseClass`

The `IPMP_Data_BaseClass` is intended to be extended to provide the carriage of ISO defined as well as user defined IPMP related data.

Syntax

```

abstract aligned(8) expandable(2^28-1) class IPMP_Data_BaseClass:
    bit(8) tag=0...255
{
    bit(8) Version;
    bit(32) dataID;
    // Fields and data extending this message.
}

```

Semantics

`Version` - indicates the version of syntax used in the IPMP Data and shall be set to “0x01”.

`dataID` – used for the purpose of identifying the message. Tools replying directly to a message shall include the same `dataID` in any response.

`tag` indicates the tag for the extended IPMP data.

IPMP data extending from `IPMP_Data_BaseClass` can be carried in the following three places:

- `IPMP_Descriptor`
- `IPMP_Message` which is subsequently carried in IPMP Stream.
- `IPMP_MessageFromTool` defined to carry messages between IPMP tools.

Table AMD3-1 — Tags for IPMP Data extending IPMP_Data_BaseClass

| 8-bit Tag Value | Symbolic Name |
|-----------------|---|
| 0x00 | Forbidden |
| 0x01 | IPMP_OpaqueData_tag |
| 0x02 | IPMP_AudioWatermarkingInit_tag |
| 0x03 | IPMP_VideoWatermarkingInit_tag |
| 0x04 | IPMP_SelectiveDecryptionInit_tag |
| 0x05 | IPMP_KeyData_tag |
| 0x06 | IPMP_SendAudioWatermark_tag |
| 0x07 | IPMP_SendVideoWatermark_tag |
| 0x08 | IPMP_RightsData_tag |
| 0x09 | IPMP_Secure_Container_tag |
| 0x0A | IPMP_AddToolNotificationListener_tag |
| 0x0B | IPMP_RemoveToolNotificationListener_tag |
| 0x0C | IPMP_InitAuthentication_tag |
| 0x0D | IPMP_MutualAuthentication_tag |
| 0x0E | IPMP_UserQuery_tag |
| 0x0F | IPMP_UserQueryResponse_tag |
| 0x10 | IPMP_ParametricDescription_tag |
| 0x11 | IPMP_ToolParamCapabilitiesQuery_tag |
| 0x12 | IPMP_ToolParamCapabilitiesResponse_tag |
| 0x13 | IPMP_GetTools_tag |
| 0x14 | IPMP_GetToolsResponse_tag |
| 0x15 | IPMP_GetToolContext_tag |
| 0x16 | IPMP_GetToolContextResponse_tag |
| 0x17 | IPMP_ConnectTool_tag |
| 0x18 | IPMP_DisconnectTool_tag |
| 0x19 | IPMP_NotifyToolEvent_tag |
| 0x1A | IPMP_CanProcess_tag |
| 0x1B | IPMP_TrustSecurityMetadata_tag |
| 0x1C | IPMP_ToolAPI_Config_tag |

| | |
|-------------|------------------------------------|
| 0x1D– 0x3F | Reserved for Inter-device messages |
| 0x40 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

8.3.2.7 Mutual Authentication

This Subclause defines the syntax and semantics of messages used for mutual authentication and secure communications.

8.3.2.7.1 IPMP_InitAuthentication

This Subclause defines the syntax and semantics of a message used to initiate mutual authentication between two components as well as indicate the type of authentication required.

8.3.2.7.1.1 Syntax

```
class IPMP_InitAuthentication extends IPMP_Data_BaseClass:
bit(8) tag = IPMP_InitAuthentication_tag
{
    bit (32)    Context;
    bit (8)     AuthType;
}
```

8.3.2.7.1.2 Semantics

Context – the 32-bit Context ID of the logical instance of the Tool with which mutual authentication is to be performed. In the case of this message being contained in the bitstream, the only possible value for Context is “0”, the Context ID of the Terminal, as that is the only context ID that can be known in advance. In the case of this message being used between instantiated tools, Context shall include the actual Context ID of the required tool.

AuthType has the following values .

| Value of AuthType | Semantic Meaning |
|-------------------|---------------------------------|
| 0x00 | Forbidden |
| 0x01 | No Authentication Required |
| 0x02 | No ID verify, Do secure channel |
| 0x03 | Do ID verify, No secure channel |
| 0x04 | Do ID verify, Do secure channel |
| 0x05-0xFE | ISO Reserved |
| 0xFF | Forbidden |

8.3.2.7.1.4 Response

IPMP_Mutual_Authentication between receiving tool and indicated tool.

8.3.2.7.2 IPMP_Mutual_Authentication

This Subclause defines the syntax and semantics of a message used to negotiate the protocol used for mutual authentication as well as carrying out the agreed upon protocol. Additionally the message is used to negotiate how the secured communication channel is to be used.

8.3.2.7.2.1 Syntax

```
class IPMP_Mutual_Authentication extends IPMP_Data_BaseClass
: bit(8) tag=IPMP_MutualAuthentication_tag;
{
    bit (1)      requestNegotiation;
    bit (1)      successNegotiation;
    bit (1)      failedNegotiation;
    bit (1)      inclAuthenticationData;
    bit (1)      inclAuthCodes;
    const bit (3) reserved = 0b000;
    if (requestNegotiation) {
        bit(8)                  nCandidateAlgorithm;
        AlgorithmDescriptor     candidateAlgorithms[];
    }
    if (successNegotiation) {
        bit(8)                  nAgreedAlgorithm;
        AlgorithmDescriptor     agreedAlgorithms[];
    }
    if (inclAuthenticationData) {
        ByteArray               AuthenticationData;
    }
    if (inclAuthCodes) {
        unsigned int            type;
        if (type == 0x01) {
            unsigned int          nCertificate;
            unsigned int          certType;
            ByteArray             certificates[nCertificate];
        } elseif (type == 0x02) {
            KeyDescriptor         publicKey;
        } elseif (type == 0xFE) {
            ByteArray             opaque;
        }
        IPMP_TrustSecurityMetadata   trustData;
        ByteArray               authCodes;
    }
}
```

8.3.2.7.2.2 Semantics

An instance of IPMP_Mutual_Authentication is generated by and exchanged between IPMP tools, and IPMP Tools and the Terminal for the purpose of mutual authentication.

inclAuthCodes – if this flag is set, authentication codes for the current message are specified.

`type` – specifying the type of the authentication codes. Semantics of each value for this variable is defined as follows:

| Value of Type | Semantics |
|---------------|--|
| 0x00: | No information regarding the type is explicitly specified. |
| 0x01 | The value specified in the variable <code>authCodes</code> is digital signature. One or more SPKI certificates or X.509 V3 certificates, depending on the value of <code>certType</code> are specified as a method to verify the signature in the variable <code>certificates[]</code> . |
| 0x02 | The value specified in the variable <code>authCodes</code> is a digital signature. At the same time, a public key accompanied by algorithm specification is specified as a method to verify the signature. |
| 0x03 – 0xDF | ISO Reserved. |
| 0xE0 – 0xFD | User Private. |
| 0xFE | Application-dependent information regarding the type is specified in the variable <code>opaque</code> . |
| 0xFF | Forbidden. |

`certType` – specifies type of a certificate, value assigned by a Registration Authority.

`certificates []` – specifies data of one or more certificates. The certificate type is determined by the value of `certType`. This variable is specified, only when the variable `type` specifies 0x01.

`publicKey` – specifies a cryptographic public key accompanied by algorithm specification. This variable is specified, if the variable `type` specifies 0x02.

`opaque` – specifies an application-dependent method to verify the authentication codes. This variable is specified if the variable `type` specifies 0xFE.

`trustData` – if present, specifies trust and security metadata.

`authCodes` – specifies authentication codes to this message. Note that data to be signed excludes data beginning at the `type` specification of the `authCodes`.

`requestNegotiation` – indicates that the originator is requesting negotiation about an authentication method to be used in the subsequent communication.

`candidateAlgorithms` – specifies a list comprised of one or more algorithm identifiers of candidate authentication methods. The originator of the `IPMP_Mutual_Authentication` message shall specify identifiers of algorithms and/or protocols that it supports. The recipient of this message shall select ones out of the list to fulfil the requirements, which the recipient IPMP tool supports. The recipient sends another `IPMP_Mutual_Authentication` message such that `agreedAlgorithm` specifies the identification of the selected algorithms and/or protocols. If the recipient cannot find algorithms and/or protocols that it supports in the list, it returns an `IPMP_Mutual_Authentication` message specifying a "0b1" for `failedNegotiation`. The syntax of `AlgorithmDescriptor` is provided in [8.3.2.7.2.6].

NOTE When the field `candidateAlgorithms` contains algorithms of mutual authentication that support the generation of a shared secret, additional algorithm identifiers are listed to support the negotiation of message encryption, and message authentication. The purpose of each algorithm included will be implicit from its functionality. i.e. if DES is a candidate algorithm it is assumed it is specified for message encryption/decryption.

Additional Note: For algorithms that support a number of options within one algorithm such as AES supporting a number of block lengths and key lengths, only one configuration will be specified for a given identifier or registration authority listed ID. Additionally padding requirements and solutions will be included in the identifiers and IDs as well.

`inclAuthenticationData` – when set to ‘1’, this implies that the message contains method specific data used during mutual authentication.

`AuthenticationData` – specifies data to be used for mutual authentication and whose value depends on method specific processing. This variable exists only when the flag `inclAuthenticationData` is set.

8.3.2.7.2.3 Response

`IPMP_Mutual_Authentication`, until authentication is successful.

8.3.2.7.2.4 BaseAuthenticationDescriptor

This Subclause defines the syntax and semantics for a descriptor that defines a base from which authentication descriptors may be extended.

8.3.2.7.2.4.1 Syntax

```
abstract aligned(8) expandable(2^28 -1) class BaseAuthenticationDescriptor : bit(8) tag=0 {
// empty. To be filled by classes extending this class.
}
```

tag table

| | |
|-----------|-------------------------|
| 0x00 | Forbidden |
| 0x01 | IPMP_AlgorithmDescr_tag |
| 0x02 | IPMP_KeyDescr_tag |
| 0x03-0x7F | ISO Reserved |
| 0x7F-0xFE | User defined |
| 0xFF | Forbidden |

8.3.2.7.2.5 Key Descriptor

This Subclause defines the syntax and semantics for the carriage of a cryptographic key.

8.3.2.7.2.5.1 Syntax

```
class KeyDescriptor extends BaseAuthenticationDescriptor:
bit(8) tag = IPMP_KeyDescr_tag
{
    ByteString keyBody;
}
```

8.3.2.7.2.5.2 Semantics

This class is for specifying a cryptographic algorithm and a key conforming to the algorithm.

keyBody – the body of the key. The value shall be data that conforms to a rule for data structure of the key defined outside of this document.

Example – If an encryption algorithm is RSA, the value of this parameter shall be the BER encoded data which conforms to PKCS#1.

```
RSApublicKey ::=  
SEQUENCE {  
    modulus      INTEGER, -- n  
    publicExponent  INTEGER -- e  
}
```

8.3.2.7.2.6 AlgorithmDescriptor

This Subclause defines the syntax and semantics for the carriage of a cryptographic algorithm or protocol identification.

8.3.2.7.2.6.1 Syntax

```
class AlgorithmDescriptor extends BaseAuthenticationDescriptor:  
bit(8) tag = IPMP_AlgorithmDescr_tag {  
  
    bit (1)   isRegistered;  
    const bit (7)   reserved = 0b0000.000;  
    if (isRegistered) {  
        bit (16)   regAlgoID;  
    }  
    else {  
        ByteArray   specAlgoID;  
    }  
    ByteArray OpaqueData;  
}
```

8.3.2.7.2.6.2 Semantics

This class is for specifying an identifier of an arbitrary algorithm.

isRegistered – a 0b1 indicates the ID included is a normative identifier of the algorithm. A value of “0b0” indicates the algorithm is identified by an ID assigned by a registration authority

regAlgoID – a identifier of the algorithm as assigned by a registration authority.

specAlgoID – a normative identifier of the algorithm.

SpecAlgOID –

| SpecAlgOID | Content | Confidentiality | Integrity |
|------------------|--|-----------------|-----------|
| DH-G-H-x-y | Diffie-Hellman Key Agreement Scheme on a base group G. The parameter setting of the both parties is specified in certificates. | No | Yes |
| EDH-G-H-x-y | Ephemeral Diffie-Hellman Key Agreement Scheme on a base group G. Both parties are assumed to agree on the base group G, and each party is supposed to generate ephemeral parameters (a public key pair) for the purpose of authentication and the parameters are submitted being signed by the party. A certificate of the party is used for the opponent party to verify the signature. | No | Yes |
| DH-G-E-H-x-y-z | DH-G-H-x-y being used in combination with a symmetric key cipher algorithm E. | Yes | Yes |
| EDH-G-E-H-x-y-z | EDH-G-H-x-y being used in combination with a symmetric key cipher algorithm E. | Yes | Yes |
| RSA-OAEP-H-x | Needham-Schroeder Scheme deploying RSA-based OAEP as the public key encryption. | No | Yes |
| RSA-OAEP-E-H-x-z | RSA-OAEP-H-x being used in combination with a symmetric key cipher algorithm E. | Yes | Yes |
| SCHNRR- G-x-y | Schnorr Identification Scheme on a base group G. | No | No |

In the above table, the significance of the variables is as follows:

| Variable | Definition |
|----------|---|
| G | Specifies the type of a base group (e.g. a sub-groups of an elliptic curve) |
| E | Specifies a symmetric key cipher algorithm to realize confidentiality of messages. |
| H | Specifies a hash function to realize message integrity. Hash function to be used being SHA-1. |
| X | Specifies the size of a base field (e.g. the length in bits of the base field of an elliptic curve). |
| Y | Specifies a size of the order of the base group (e.g. the length in bits of the order of a base group). |
| Z | Specifies the length in bits of a symmetric key cipher to be used. |

Remark. The actual cryptographic scheme is constructed on a proper sub-group instead of being constructed on an entire elliptic curve or an entire multiplicative group of a finite field. Further, the order of the base sub-group shall be a prime number, and its length is specified to be y bits. This value of y influences the strength of the scheme against the Pohlig-Hellman method, which finds solutions to DLP on arbitrary groups.

Generation of a MAC

In the case where a value is specified for the variable H, if either or both of the parties require the functionality of message integrity, MAC (Message Authentication Code) is attached to messages. Usage of a MAC as part of the message is optional. MAC is generated based on the hash function specified by the variable H and the shared secret being used as a key to generate MAC. MAC is generated in accordance with the following formula, where H denotes Hashing and | denotes concatenation.

```
MAC = H(H(Shared_Secret) | Message | H(Shared_Secret))
```

Generation of Keys for Message Encryption

Keys of a symmetric key cipher to be used between the parties are generated from the secret shared by the parties through the authentication procedures. For example, in the case that the key length is specified as 56 bits, the write_key_A, which the party A uses to encrypt messages, is generated by the following formula.

```
write_key_A = TRUNC(56, SHA-1(100_LSBits_of_Secret | "WRITE" | ID_OF_A | Rest_of_Secret))
ID_OF_A is defined as the byte data with value "0" if Party A is the initiator of the communication, whilst it is the byte data with value 0xFF otherwise.
```

8.3.2.7.2.7 IPMP_TrustSecurityMetadata

This Subclause defines syntax and semantics used to carry security audit and/or trust related information.

8.3.2.7.2.7.1 Syntax

```
class IPMP_TrustSecurityMetadata : public IPMP_Data_BaseClass
: bit(8) tag = IPMP_TrustSecurityMetadata_tag
{
    bit(16) numTrustedTools;
    for (int I=0; I<numTrustedTools; I++)
    {
        bit(128) toolID;
        DateClass AuditDate;
        bit(16) numTrustSpecification;
        for (int i=0; i<numTrustSpecification; i++)
        {
            bit (1) hasCCBasedTrustMetadata;
            const bit(7) reserved = 0b0000.000;

            if (!hasCCBasedTrustMetadata) {
                DateClass startDate;
                bit(2) attackerProfile;
                const bit(6) reserved = 0b0000.00;
                bit(32) trustedDuration;
            } else {
                ByteArray CCTrustMetadata;
            }
        }
    }
}
```

8.3.2.7.2.7.2 Semantics

For numTrustedTools referenced by toolID, the trust metadata for each tool consists of the date of audit, AuditDate by the trust auditor.

For each of numTrustSpecification, the tool shall be trusted as of startDate, to protect against the specified AttackerProfile for the TrustedDuration minutes.

Or an alternative, though opaque, means of specifying the trust metadata using Common Criteria contained in CCTrustMetadata.

Attacker profile is defined as class I, II, or III where;

| | |
|-------------|--------------|
| 0x00 | forbidden |
| 0x01 | Class I |
| 0x02 | Class II |
| 0x03 | Class III |
| 0x04 – 0x0F | User defined |
| 0x10 – 0xFE | ISO reserved |
| 0xFF | forbidden |

8.3.2.7.2.7.3 DateClass

This Subclause defines syntax and semantics for the carriage of date related information.

8.3.2.7.2.7.3.1 Syntax

```
class DateClass : {
    bit(40) Date;
}
```

8.3.2.7.2.7.3.2 Semantics

This descriptor identifies the date on which the audit took place.

Date – contains the audit date of IPMP tool in question, in Universal Time, Co-ordinated (UTC) and Modified Julian Date (MJD). This field is coded as 16 bits giving the 16 least significant bits of MJD followed by 24 bits coded as 6 digits in 4-bit Binary Coded Decimal (BCD). If the audit date is undefined all bits of the field are set to 1.

8.3.2.7.3 IPMP_SecureContainer

This Subclause defines syntax and semantics for the carriage of secured data as well as indicating how the contained data is secured.

8.3.2.7.3.1 Syntax

```
class IPMP_SecureContainer extends IPMP_Data_BaseClass
: bit(8) tag = IPMP_Secure_Container_tag
{
    bit(1) hasEncryption;
    bit(1) hasMAC;
    bit(1) isMACEncrypted;
    const bit(5) reserved=0b0000.0;

    if(hasEncryption)
        ByteArray encryptedData;

        if(hasMAC && !isMACEncrypted) {
            ByteArray MAC;
        }
    }
    else {
        IPMP_Data_BaseClass protectedMsg;
        if(hasMAC) {
```

```

        ByteArray MAC;
    }
}
}

```

8.3.2.7.3.2 Semantics

This forms a secure container for any message extending the `IPMP_Data_BaseClass`. The use of this message is optional and is defined for transmitting any message in a secure manner when needed by the application. The payload message is optionally encrypted. The MAC allows verification of the integrity of the `protectedMsg`, and is optionally encrypted. The key and algorithm for creating and verifying the MAC, and decrypting the encrypted payload, is negotiated as part of an external authentication mechanism.

`hasEncryption` – Indicates that the encrypted message is contained in `encryptedData`.

`hasMAC` – Indicates that a MAC, Message Authentication Code is contained in the field `MAC`.

`isMACEncrypted` – indicates that the encrypted portion contained in `encryptedData` also contains MAC information.

`protectedMsg` – Unencrypted message derived from `IPMP_Data_BaseClass` to which the contained MAC has been applied.

8.3.2.8 IPMP Tool connection and disconnection

This clause defines syntax and semantics for messages related to:

- Querying the availability of either IPMP Tool availability or the Terminal's internally implemented IPMP capabilities.
- The acquiring of tools contained in the bit stream.
- The requesting of IPMP capabilities of a given IPMP Tool or the Terminal.
- Requesting the instantiation and disconnection of IPMP Tools either as discrete loadable entities or requesting the use of the Terminal's internally implemented IPMP capabilities.
- Requesting a communication channel to an already instantiated tool.

8.3.2.8.1 IPMP_GetTools

This Subclause defines syntax and semantics to request available IPMP Tools or capabilities on/of the Terminal.

8.3.2.8.1.1 Syntax

```

class IPMP_GetTools extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_GetTools_tag
{
}

```

8.3.2.8.1.2 Semantics

Message `IPMP_GetTools` is used by a tool to find all the Tools, instantiated or not, that are available on the terminal.

8.3.2.8.1.3 Response

IPMP_GetToolsResponse.

8.3.2.8.2 IPMP_GetToolsResponse

This Subclause defines syntax and semantics to inform the presence of available IPMP Tools or capabilities on/of the Terminal.

8.3.2.8.2.1 Syntax

```
class IPMP_GetToolsResponse extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_GetToolsResponse_tag
{
    IPMP_Tool tools[];
}
```

8.3.2.8.2.2 Semantics

tools – A list of tools available to the Terminal.

8.3.2.8.2.3 Response

None required

8.3.2.8.3 IPMPToolES_DecoderConfig

This Subclause defines syntax and semantics for the configuration of the Terminal to receive an IPMP Tool contained in the bitstream.

8.3.2.8.3.1 Syntax

```
class IPMPToolES_DecoderConfig extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag
{
    bit(128)      IPMP_ToolID;
    bit(1)        hasFormatID;
    bit(1)        hasPackageID;
    const bit(6)   reserved = 0b0000.00;
    if (hasFormatID)
        bit(32)      Tool_Format_ID;
    if (hasPackageID)
        bit(16)      Tool_Package_ID;
    ByteArray     OpaqueData;
}
```

8.3.2.8.3.2 Semantics

IPMP_ToolID – the ID of the Tool carried in this stream.

Tool_Format_ID – This is defined as 0x0001 for a structurally described tool. Otherwise, the Tool_Format_ID indicates the Binary Representation of the Tool and is assigned by a registration authority.

Tool_Package_Id – a 16-bit unsigned integer that indicates the details of the package of the Tool – examples are CAB, Zip, TAR. Values are assigned by a registration authority.

OpaqueData – Any opaque data.

A streamType identifier “IPMPToolStream” is defined for elementary streams to carry binary IPMP Tools in ISO/IEC 14496-1.

One implementation of a given tool is carried as the payload of one IPMP Tool stream, the representation format, package information and IPMP Tool ID of which is specified in DecoderConfigDescriptor in the associated ESD.

IPMP_ToolESS shall be referenced through the IOD. The IPMP Tool Manager serves as a decoder for IPMP Tool Streams. IPMP Tools carried within IPMP_ToolESS become part of the Terminal resources, and shall be installed, used and retained at the discretion of the Terminal implementation. As such, once the downloaded tool is installed or otherwise made available to the Terminal implementation, it shall be referenced via its IPMP Tool ID just like any other IPMP Tool.

Handling and usage of Tools carried in Tool elementary streams are implementation dependant.

8.3.2.8.4 IPMP_ToolES_AU

This Subclause defines syntax and semantics of the Access Unit which carries IPMP Tools in the bitstream.

8.3.2.8.4.1 Syntax

```
class IPMP_ToolES_AU
{
    bit(1) isSigned;
    const bit(7) reserved = 0b0000.000;
    if (isSigned)
    {
        ByteArray IPMP_Tool_Signature;
        bit(16) numCerts;
        for(int i=0; i<numCerts; i++)
        {
            bit(8) CertType;
            ByteArray certificates[numCerts];
        }
        bit(128) Verifying_Tool_Id;
    }
    bit(32) sizeOfTool;
    bit(8) Tool_Body[sizeOfTool];
}
```

8.3.2.8.4.2 Semantics

IsSigned – When set to ‘1’, shall indicate the presence of a signature in the tool stream.

IPMP_Tool_Signature – the signature of the IPMP Tool being delivered in Tool_Body in the tool stream.

NumCerts – The number of certificates included.

CertType – The type of certification mechanism being used, value assigned by a Registration Authority.

Certificates – The array of certificates.

Verifying_Tool_Id – The ID of the Tool that is required to verify the certificate(s). This shall be the ID of the Terminal or a trusted tool. When the Verifying_Tool_ID is implicit by the CertType and/or certificates, this shall be set to 0.

SizeOfTool – the size in bytes of the Tool Body

Tool_Body – the tool.

8.3.2.8.5 IPMP Tool Parametric Capabilities Query

This Subclause defines syntax and semantics to request IPMP capabilities available from either IPMP Tools or the Terminal.

8.3.2.8.5.1 Syntax

```
class IPMP_ToolParamCapabilitiesQuery extends IPMP_Data_BaseClass
: bit(8) tag = IPMP_ToolParamCapabilitiesQuery_tag
{
    IPMP_ParametricDescription          toolParamDesc;
}
```

8.3.2.8.5.2 Semantics

This message allows a terminal to query a tool as for support for a specific parametric description. The contents of the message are the actual tool parametric descriptor that would be contained in the tools list.

toolParamDesc: The parametric description of the capability being queried.

8.3.2.8.5.3 Response

IPMP_ToolParamCapabilitiesResponse.

8.3.2.8.6 IPMP Tool Parametric Capabilities Query Response

This Subclause defines syntax and semantics to inform the IPMP Capabilities of an IPMP Tool or the Terminal.

8.3.2.8.6.1 Syntax

```
class IPMP_ToolParamCapabilitiesResponse extends IPMP_Data_BaseClass
: bit(8) tag = IPMP_ToolParamCapabilitiesResponse_tag
{
    bit(1) capabilitiesSupported;
    const bit(7) reserved = 0b0000.000;
}
```

8.3.2.8.6.2 Semantics

This message is the response to the above parametric capabilities query and simply returns a boolean value as to whether or not the parametric description is supported by the tool.

capabilitiesSupported: If this bit is set to '1', this implies that the tool does support the parametric description queried in the preceding message. If set to '0' this implies that the tool does not support the parametric description.

8.3.2.8.6.3 Response

None required.

8.3.2.8.7 IPMP_ConnectTool

This Subclause defines syntax and semantics used to request the instantiation of an IPMP tool. Note, this request may be satisfied by either the loading/instantiation of a discrete loadable IPMP Tool or by the Terminal making the requested IPMP functionality available at the point requested.

8.3.2.8.7.1 Syntax

```
class IPMP_ConnectTool extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_ConnectTool_tag
{
    IPMP_Descriptor toolDescriptor;
}
```

8.3.2.8.7.2 Semantics

Message `IPMP_ConnectTool` allows a tool to request the Terminal to create a connection to a tool identified in the `toolDescriptor`.

`toolDescriptor` - contains an IPMP descriptor to be used for determining location of new tool context to be connected. Scope of connected tool shall be the same as the requesting tool.

The Terminal shall link the new Tool Context to the Message router, before it responds to this message.

8.3.2.8.7.3 Response

`IPMP_NotifyToolEvent` with an `eventType` of “CONNECTED” or an `eventType` of “CONNECTIONFAILED”.

8.3.2.8.8 IPMP_DisconnectTool

This Subclause defines syntax and semantics used to inform that a given IPMP Tool, or Terminal IPMP functionality is no longer needed. Note, the precise timing of when the IPMP Tool or functionality becomes no longer available, one should assume that once the request is made, no further use of the IPMP Tool or functionality is possible.

8.3.2.8.8.1 Syntax

```
class IPMP_DisconnectTool extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_DisconnectTool_tag
{
    bit(32) IPMP_ToolContextID;
}
```

8.3.2.8.8.2 Semantics

Message `IPMP_DisconnectTool` allows a tool to disconnect a tool it has previously connected at a control point.

`IPMP_ToolContextID` is the ID of the Tool Context to be disconnected. `IPMP_ToolContextID` is randomly generated by the Terminal and is to be unique for each connected IPMP tool.

8.3.2.8.8.3 Response

`IPMP_NotifyToolEvent` - with an `eventType` of “DISCONNECTED” or an `eventType` of “DISCONNECTIONFAILED”.

8.3.2.8.9 IPMP_GetToolContext

This Subclause defines syntax and semantics to request the logical address of a given IPMP Tool or Terminal provided IPMP functionality for messaging purposes.

8.3.2.8.9.1 Syntax

```
class IPMP_GetToolContext extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_GetToolContext_tag
{
    bit(3) scope;
    bit(1) hasIPMPDescriptorIDEx;
    const bit(4) reserved = 0b0000;

    if (hasIPMPDescriptorID)
        bit(16) IPMP_DescriptorIDEx;
}
```

8.3.2.8.9.2 Semantics

The value of the `scope` parameter can be:

`SCOPE_ESD` = 0x0

`SCOPE_OD` = 0x1

`SCOPE_LOCAL` = 0x2

Other values are reserved for future use.

When called with a scope of `SCOPE_ESD`, this message will limit the search to all tools protecting the same elementary stream as the tool who sends the message is protecting.

When called with a scope of `SCOPE_OD`, this message will limit the search to all tools declared in the same OD as the tool who sends the message is declared in (at the OD level or the ESD level).

When called with a scope of `SCOPE_LOCAL`, this message will limit the search to all tools declared in the same name scope as the tool which sends the message is declared in.

`IPMP_DescriptorIDEx` – an optional parameter to limit reply to tools from a given declaration.

8.3.2.8.9.3 Response

`IPMP_GetToolContextResponse`.

8.3.2.8.10 IPMP_GetToolContextResponse

This Subclause defines syntax and semantics used to inform the logical address of a requested IPMP Tool or Terminal provided functionality.

8.3.2.8.10.1 Syntax

```
class IPMP_GetToolContextResponse extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_GetToolContextResponse_tag
{
    bit(1) hasESD_ID;
    bit(5) reserved = 0.0000b;
    bit(10) OD_ID;
    if (hasESD_ID)
        bit(16) ESD_ID;
    bit(32) IPMP_ToolContextID;
}
```

Where `OD_ID` is the ID of the OD where the tool is declared (at the OD level or ESD level), and `ESD_ID`, if present, is the ID of the ESD where the tool is declared.

8.3.2.8.10.2 Semantics

`IPMP_ToolContextID` - is the identifier of the tool Context. A null value indicates that this context does not exist.

8.3.2.8.10.3 Response

None required.

8.3.2.9 IPMP Tool notification

This clause defines syntax and semantics used for:

- A request to be notified in the event that an IPMP Tool is instantiated.
- A request to terminate IPMP Tool instantiation notification.
- The notification of an instantiation.

8.3.2.9.1 `IPMP_AddToolNotificationListener`

This Subclause defines syntax and semantics to request notification of the defined events of IPMP Tools.

8.3.2.9.1.1 Syntax

```
class IPMP_AddToolNotificationListener extends IPMP_Data_BaseClass :
bit(8) tag = IPMP_AddToolNotificationListener_tag
{
    bit(3) scope;
    bit(5) reserved; 0b0000.0
    bit(8) eventTypeCount;
    bit(8) eventType[eventTypeCount];
}
```

8.3.2.9.1.2 Semantics

Message `IPMP_AddToolNotificationListener` allows an existing IPMP Tool running on the terminal to request notification of any defined event in the terminal.

`scope` - The value of the `scope` parameter can be:

`SCOPE_ESD` = 0x0

`SCOPE_OD` = 0x1

`SCOPE_LOCAL` = 0x2

Other values are reserved for future use.

When called with a scope of `SCOPE_ESD`, this message will limit notifications for tools protecting the same elementary stream as the tool who sends the message.

When called with a scope of `SCOPE_OD`, this message will limit notifications for tools protecting the same OD as the tool who sends the message is declared in (at the OD level or the ESD level).

When called with a scope of `SCOPE_LOCAL`, this message will limit notifications to all tools connected in the same name scope as the tool who sends the message is declared in.

`eventType` – Type of event for which the sender shall receive notifications for and defined by the following table.

| | |
|-----------|---------------------|
| 0x00 | CONNECTED |
| 0x01 | CONNECTIONFAILED |
| 0x02 | DISCONNECTED |
| 0x03 | DISCONNECTIONFAILED |
| 0x04 | WATERMARKDETECTED |
| 0x05–0xC0 | ISO Reserved |
| 0xC1–0xFF | User Defined |

8.3.2.9.1.3 Response

None required.

8.3.2.9.2 IPMP_RemoveToolNotificationListener

This Subclause defines syntax and semantics used to request the termination of instantiation notifications.

8.3.2.9.2.1 Syntax

```
class IPMP_RemoveToolNotificationListener extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_RemoveToolNotificationListener_tag
{
    bit(8) eventTypeCount;
    bit(8) eventType[eventTypeCount];
}
```

8.3.2.9.2.2 Semantics

Message `IPMP_RemoveToolNotificationListener` allows an existing IPMP Tool running on the terminal to terminate the receipt of a previous registered event listener. If an `eventTypeCount` of "0" is present, all previously registered event types shall be unregistered.

8.3.2.9.2.3 Response

None required.

8.3.2.9.3 IPMP_NotifyToolEvent

This Subclause defines syntax and semantics used to notify an IPMP tool that has requested the notification of IPMP Tool instantiations that an IPMP Tool has been instantiated. Note, this message is to be delivered to both IPMP Tools that have requested notification as well as IPMP Tools that have requested the instantiation of a given IPMP Tool.

8.3.2.9.3.1 Syntax

```
class IPMP_NotifyToolEvent extends IPMP_Data_BaseClass:
    bit(8) tag = IPMP_NotifyToolEvent_tag
{
    bit(1) hasID;
    bit(7) reserved; 0b0000.000
    if (hasID) {
        bit(10) OD_ID;
        bit(6) reserved; 0b0000.00
        bit(16) ESD_ID;
    }
    bit(8) eventType;
    bit(32) toolContextID;
}
```

8.3.2.9.3.2 Semantics

Message IPMP_NotifyToolEvent notifies an IPMP Tool of a tool event for which it had previous registered as a listener.

HasID – Indicates that the tool is connected to a given stream declared within the given OD and/or ESD.

OD_ID – The ID of the OD in which the stream that the tool has been connected to.

ESD_ID - The ID of the stream that the tool has been connected to.

toolContextID – the ContextID of the tool either connected or disconnected, or the failed state of either, as indicated by the eventType.

8.3.2.9.3.3 Response

None required.

8.3.2.10 IPMP Processing

This Subclause defines syntax and semantics for the carriage of common IPMP information including:

- The notification from IPMP Tools to begin or discontinue stream processing.
- Opaque data.
- Cryptographic key data as well as the term or validity information.
- Rights expressions.
- Information used to parametrically configure decryption services.
- Information used to parametrically configure watermarking services.
- Information to be embedded or has been extracted using watermarking services.

8.3.2.10.1 IPMP_CanProcess

This Subclause defines syntax and semantics for IPMP Tools to notify the Terminal of the ability to begin or requirement to discontinue stream processing.

8.3.2.10.1.1 Syntax

```
class IPMP_CanProcess extends IPMP_Data_BaseClass:
bit(8) tag = IPMP_CanProcess_tag
{
    bit(1) canProcess;
    bit(7) reserved = 0b0000.000;
}
```

8.3.2.10.1.2 Semantics

`canProcess` – used to indicate to the receiver of the message that the sender is able to begin processing data or must discontinue processing.

| | |
|-----|-------------|
| 0x0 | DISCONTINUE |
| 0x1 | BEGIN |

8.3.2.10.2 IPMP_OpaqueData

This Subclause defines syntax and semantics for the carriage of opaque data.

8.3.2.10.2.1 Syntax

```
class IPMP_OpaqueData extends IPMP_Data_BaseClass
: bit(8) tag = IPMP_OpaqueData_tag
{
    ByteArray opaqueData;
}
```

8.3.2.10.2.2 Semantics

`opaqueData` – information to be delivered.

8.3.2.10.3 IPMP_KeyData

This Subclause defines syntax and semantics for the carriage of cryptographic data as well as the indication of the terms of validity for the contained key.

8.3.2.10.3.1 Syntax

```
class IPMP_KeyData extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_KeyData_tag
{
    ByteArray keyBody;
    bit(1) hasStartDTS;
    bit(1) hasStartPacketID;
    bit(1) hasExpireDTS;
    bit(1) hasExpirePacketID;
    const bit(4) reserved = 0b0000;
    if (hasStartDTS)
    {
        bit(64) startDTS;
    }
    if (hasStartPacketID)
        bit(32) startPacketID;
    if (hasExpireDTS)
    {
        bit(64) expireDTS;
    }
    if (hasExpirePacketID)
        bit(32) expirePacketID;
    ByteArray OpaqueData;
}
```

8.3.2.10.3.2 Semantics

`keyBody` – the body of the key. The value shall be data that conforms to a rule for data structure of the key defined outside of this document.

hasStartDTS – a value of “1” indicates the presence of the following `startDTS` field.

hasStartPacketID – a value of “1” indicates the presence of the following `startPacketID` field.

hasExpireDTS – a value of “1” indicates the presence of the following `expireDTS` field.

hasExpirePacketID – a value of “1” indicates the presence of the following `expirePacketID` field.

`startDTS` – decoding time stamp of the first access unit for which the contained key is valid;

`startPacketID` – the packet ID of the first access unit for which the contained key is valid.

`expireDTS` – decoding time stamp of the first access unit for which the contained key is no longer valid;

`expirePacketID` – the packet ID of the first access unit for which the contained key is no longer valid.

`OpaqueData` – Any other opaque data carried in this IPMP data.

8.3.2.10.4 IPMP_RightsData

This Subclause defines syntax and semantics to carry rights expressions.

8.3.2.10.4.1 Syntax

```
class IPMP_RightsData extends IPMP_Data_BaseClass :  
    bit(8) tag = IPMP_RightsData_tag  
{  
    ByteArray rightsInfo;  
}
```

8.3.2.10.4.2 Semantics

`rightsInfo` – This contains the details of usage rights information.

8.3.2.10.5 IPMP_SelectiveDecryptionInit

Defined in **Error! Reference source not found..**

8.3.2.10.6 IPMP_AudioWatermarkingInit

Defined in Annex B.

8.3.2.10.7 IPMP_SendAudioWatermark

Defined in Annex B.

8.3.2.10.8 IPMP_VideoWatermarkingInit

Defined in Annex C.

8.3.2.10.9 IPMP_SendVideoWatermark

Defined in Annex C.

8.3.2.11 User Interaction Messages

This clause defines syntax and semantics for messages which allow information to be exchanged between the User and an entity requiring information from the User. Although the word ‘text’ is used repeatedly throughout the following syntax and semantics, how the requested information is displayed or presented to the user as well as how the User supplies possibly requested information is application and implementation dependent. An example could be that although text may be requested with a textual prompt, the User input and output available on the Terminal may be voice recognition and generation instead.

8.3.2.11.1 IPMP_UserQuery

This Subclause defines syntax and semantics used to request or present information from/to the User.

8.3.2.11.1.1 Syntax

```
class IPMP_UserQuery extends IPMP_Data_BaseClass:
bit(8) tag = IPMP_UserQuery_tag
{
    bit(1)      inclDisplayTitle;
    bit(1)      incldisplayText;
    bit(1)      needReplyText;
    bit(1)      inclOptionSelect;
    bit(1)      inclSMIL;
    const bit(3) reserved = 0b000;
    bit(24)     numOfAltText;
    for(int i=0; i< numOfAltText; i++)
    {
        bit(24)      languageCode;
        if (inclDisplayTitle) {
            ByteArray titleText;
        }
        if (incldisplayText) {
            bit(8)      nDisplayText;
            DTArray   displayText[];
        }
        if (needReplyText) {
            bit(8)      nPromptText;
            QTArray   promptText[];
        }
        if (includOptionSelect) {
            bit(8)      nOption;
            OptionArray option[];
        }
        if (includSMIL) {
            bit(1)      isReferenced;
            const bit(7) reserved = 0b0000.000;
            if (isReferenced) {
                ByteArray SMIL_URL;
            }
            else {
                ByteArray SMIL;
            }
        }
    }
}
```

8.3.2.11.1.2 Semantics

`languageCode` - Contains the ISO 639-2:1998 bibliographic three character language code of the corresponding audio/speech or text object that is being described.

`titleText` - Title of dialog display.

`displayText` - Text to be displayed to the user.

`needReplyText` - Text expected back from the user.

`promptText` - Text to be displayed to the end user to indicate purpose of text input field, i.e. "User ID", "Password", "PIN", etc.

`inclOptionSelect` - An option, true/false, input is needed from the user.

`isExclusive` - If more than one option is associated with a given display text, this indicates mutual exclusivity of options.

`optionText` - Text to be displayed indicating purpose of option selection, i.e. "One month purchase", "One time play", "Render at 1024/768", etc.

`SMIL_URL` - Fully qualified location of SMIL file to be displayed.

`SMIL` - SMIL file to be displayed.

8.3.2.11.1.3 DTArray

This Subclause defines syntax and semantics to carry information used to provide a general heading for the information and/or request for information presented to the User.

8.3.2.11.1.3.1 Syntax

```
class DTArray
{
    bit(16)      ID;
    ByteArray    displayText;
}
```

8.3.2.11.1.4 QTArray

This Subclause defines syntax and semantics to indicate that information is requested from the user as well as an indication of what the information that is requested is. An example could be that information is requested in textual format, such as a password or User ID and what is requested, "Password" or "User ID" is displayed textually to the User along with an appropriate area to receive textual input from the User.

8.3.2.11.1.4.1 Syntax

```
class QTArray
{
    bit(16)      ID;
    bit(16)      SubID;
    bit(1)       isHidden;
    bit(7)       reserved = 0b0000.000;
    ByteArray    promptText;
}
```

8.3.2.11.1.5 OptionArray

This Subclause defines syntax and semantics to indicate a single option or choice must be made. If more than one `OptionArray` is included with the same `ID`, the `isExclusive` bit may be used to indicate whether more than one option may be selected or if only one option of those available must be selected.

8.3.2.11.1.5.1 Syntax

```
class OptionArray
{
    bit(16)      ID;
    bit(16)      SubID;
    bit(1)       isExclusive;
    bit(7)       reserved = 0b0000.000;
    ByteArray   promptText;
}
```

8.3.2.11.1.5.2 Semantics

IsExclusive - When set to ‘1’, this implies a mutually exclusive condition of the option selector.

ID - A serial number to be associated with the contained data or to associate contained data with other data.

SubID - A serial number to associate items within an ID group.

promptText – Text to be presented to the User to indicate the type of information requested.

isHidden – If set to one, the response field for this text shall not reveal the text input by the user, e.g. password input.

8.3.2.11.1.5.3 Response

IPMP_UserQueryResponse

8.3.2.11.2 IPMP_UserQueryResponse

This Subclause defines syntax and semantics to carry information provided by the User to an IPMP_UserQuery request.

8.3.2.11.2.1 Syntax

```
class aligned (8)UserIPMP_UserQueryResponse extends IPMP_Data_BaseClass:
bit(8) tag = IPMP_UserQueryResponse_tag
{
    bit(1)           inclReplyText;
    bit(1)           inclOptionSelect;
    const bit(6)     reserved = 0b0000.00;
    bit(24)          languageCode;
    if (inclReplyText) {
        bit(8)      nReplyText;
        QTArray     ReplyText[];
    }
    if (inclOptionSelect) {
        bit(16)     numOptions;
        for (i=0; i<numOptions; i++)
        {
            bit(1)      optionResult;// 0b1 = TRUE, 0b0 = FALSE;
        }
    }
}
```

8.3.2.11.2.2 Semantics

replyText - Text entered by user. Only fields with entered text need be included. If the original request contained reply text fields but the terminal does not support text input then an **inclReplyText** of “0b0” would indicate so.

`optionResult` - Identical semantics and rules as with `replyText` except that all options must be represented and in the order they were initially specified.

8.3.2.11.2.3 Response

None Required.

8.3.2.12 IPMP Information Delivery Functions

This clause defines syntax and semantics for messages that facilitate delivery of IPMP Information among IPMP Tools and terminal, and from bitstream to IPMP Tools.

8.3.2.12.1 IPMP_ToolMessageBase

This Subclause defines syntax and semantics for a message base which can be extended to deliver information of different types to IPMP Tools.

8.3.2.12.1.1 Syntax

```
Aligned(8) abstract expandable(2^28-1) class IPMP_ToolMessageBase: bit(8) tag = 0 {
    bit(8) Version;
    bit(32) sender;
    bit(32) recipient;
}
```

8.3.2.12.1.2 Semantics

`IPMP_ToolMessageBase` - an expandable base class for IPMP Tool Messages. The extension tags are defined in Table AMD3-2.

`Version` - indicates the version of syntax used in the messages and shall be set to "0x01".

`Sender` - indicates the context ID of the originator of the message. The value "0x00" is reserved for the terminal.

`Recipient` - indicates the context ID of the intended recipient of the message. "0x00" is reserved for the terminal.

Table AMD3-2 — Tags for messages extending IPMP_ToolMessageBase

| 8-bit Tag Value | Symbolic Name |
|-----------------|----------------------------------|
| 0x00 | Forbidden |
| 0x01 | IPMP_MessageFromBitstream_tag |
| 0x02 | IPMP_DescriptorFromBitstream_tag |
| 0x03 | IPMP_MessageFromTool_tag |
| 0x04 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

8.3.2.12.2 IPMP_MessageFromBitstream

This Subclause defines syntax and semantics for an extension to `IPMP_ToolMessageBase` to support the delivery of `IPMP_Messages` to IPMP Tools. Note, the delivery of `IPMP_Messages` to IPMP Systems, as identified by `IPMP_DescriptorID`, as opposed to `IPMP_DescriptorIDEx`, is done on an implementation basis.

8.3.2.12.2.1 Syntax

```
class IPMP_MessageFromBitstream extends IPMP_ToolMessageBase :  
    bit(8) tag = IPMP_MessageFromBitstream_tag  
{  
    IPMP_Message messages[];  
}
```

8.3.2.12.2.2 Semantics

`Message IPMP_MessageFromBitstream` is used to deliver `IPMP_Messages` received in the Content to the IPMP Tool context specified in the `IPMP_Message`. If an IPMP Access Unit delivered in the IPMP Elementary Stream contains more than one `IPMP_Message` for a specific IPMP Tool, all `IPMP_Message` for that tool will be included in a single `IPMP_MessageFromBitstream` message.

`messages []` - an array of `IPMP_Message`'s.

8.3.2.12.2.3 Response

None required.

8.3.2.12.3 IPMP_DescriptorFromBitstream

This Subclause defines syntax and semantics for an extension to `IPMP_ToolMessageBase` to support the delivery of `IPMP_Descriptors` to IPMP Tools. Note, the delivery of `IPMP_Descriptors` to IPMP Systems, as identified by `IPMP_DescriptorID`, as opposed to `IPMP_DescriptorIDEx`, is done on an implementation basis.

8.3.2.12.3.1 Syntax

```
class IPMP_DescriptorFromBitstream extends IPMP_ToolMessageBase :  
    bit(8) tag = IPMP_DescriptorFromBitstream_tag  
{  
    IPMP_Descriptor toolDescriptor;  
}
```

8.3.2.12.3.2 Semantics

`Message IPMP_DescriptorFromBitstream` is used to deliver an `IPMP_Descriptor` received in the bitstream to the IPMP Tool specified in the `IPMP_Descriptor`.

`toolDescriptor` - the `IPMP_Descriptor` received in the bitstream.

8.3.2.12.3.3 Response

None required.

8.3.2.12.4 IPMP_MessageFromTool

This Subclause defines syntax and semantics for an extension to `IPMP_ToolMessageBase` to support the delivery of IPMP information to and between IPMP Tools and to and between IPMP Tools and the Terminal.

Note, the delivery of IPMP Information to IPMP Systems, as identified by `IPMP_DescriptorID`, as opposed to `IPMP_DescriptorIDEx` is done on an implementation basis.

8.3.2.12.4.1 Syntax

```
class IPMP_MessageFromTool extends IPMP_ToolMessageBase:
    bit (8) tag = IPMP_MessageFromTool_tag
{
    IPMP_Data_BaseClass messages[];
}
```

8.3.2.12.4.2 Semantics

`message` – a container for `IPMP_Data_BaseClass` derived data.

8.3.2.12.4.3 Response

Received message dependant.

8.3.2.12.5 IPMP_ToolAPI_Config

This Subclause defines syntax and semantics for the carriage of IPMP Tools' instantiation and messaging API information. When this data is put in `IPMP_Descriptor`, the carried API information applies to the IPMP Tool that is referenced by the `IPMP_ToolID` in the same `IPMP_Descriptor`, i.e., when this `Instantiation_API_ID` is present in the `IPMP_Descriptor`, the terminal should use the carried API information to instantiate and to pass messages to/from the associated IPMP Tool.

8.3.2.12.5.1 Syntax

```
class IPMP_ToolAPI_Config extends IPMP_Data_BaseClass:
    bit (8) tag = IPMP_ToolAPI_Config_Tag
{
    bit(1)      has_Instantiation_API_ID;
    bit(1)      has_Messaging_API_ID;
    const bit(6) reserved = 0b0000.00;
    if (has_Instantiation_API_ID)
        bit(32)  Instantiation_API_ID;
    if (has_Messaging_API_ID)
        bit(32)  Messaging_API_ID;
    ByteArray   OpaqueData;
}
```

8.3.2.12.5.2 Semantics

`has_Instantiation_API_ID` – Indicates that the `Instantiation_API_ID` is contained in the `IPMP_ToolAPI_Config`.

`has_Messaging_API_ID` – Indicates that the `Messaging_API_ID` is contained in the `IPMP_ToolAPI_Config`.

`Instantiation_API_ID` – A 32 bits ID that indicates the API for instantiation of the IPMP Tool and is assigned by a registration authority.

`Messaging_API_ID` – A 32 bits ID that indicates the messaging API to pass messages to/from the IPMP Tool and is assigned by a registration authority.

`OpaqueData` – Any opaque data that may assist the terminal of the instantiation or messaging of the IPMP Tool.

8.3.2.12.5.3 Response

None required.

End insertion after Subclause 8.3.2.5.2

Two additional new descriptors have been created for inclusion in the IOD. They are `IPMP_ToolsListDescrTag`, which is used to identify a descriptor class that contains the declaration of all IPMP tools required for the protection of a given MPEG-4 content and `IPMP_ToolTag`, which is used to identify a descriptor class contained within an `IPMP_ToolsListDescr` and identifies a single IPMP tool.

In Subclause 8.6.3.1, insert the following text after the existing `IPMP_DescriptorPointer` found in the `ObjectDescriptor`:

```
IPMP_Descriptor ipmpDescr [0 .. 255];
```

End Subclause 8.6.3.1 insertion.

In Subclause 8.6.3.2, insert the following text after the existing semantics for `ipmpDescrPtr[]` for the `ObjectDescriptor`:

`ipmpDescr []` – a list of `IPMP_Descriptors` that may be referenced by streams declared in `esDescr`. The array shall have any number of zero up to 255 elements. The following scope and usage rules apply:

- i. Entries in the `ipmpDescr` table define IPMP System/Tools that can be referenced by `IPMP_DescriptorPointers` located in the OD itself or ESDs declared in this OD.
- ii. OD contained `IPMP_Descriptors` have scope within the given OD only and shall not be referenced by subsequently declared IODs, ODs, streams nor available for updating via `IPMP_DescriptorUpdates`.
- iii. The OD contained `IPMP_Descriptors` shall not be referenced by IODs, ODs or streams declared in OD declared OD or Scene streams.

In Subclause 8.6.4.1, insert the following text after the existing `IPMP_DescriptorPointer` found in the `InitialObjectDescriptor`:

```
IPMP_Descriptor ipmpDescr [0 .. 255];
IPMP_ToolListDescriptor toolListDescr[0 .. 1];
```

In Subclause 8.6.4.2, insert the following text after the existing semantics for `ipmpDescrPtr[]` for the `InitialObjectDescriptor`:

`ipmpDescr []` – a list of `IPMP_Descriptors` that may be referenced by streams declared in `esDescr`. The array shall have any number of zero up to 255 elements. The following scope and usage rules apply:

- i. Entries in the `ipmpDescr` table define IPMP System/Tools that can be referenced by `IPMP_DescriptorPointers` located in the IOD itself or ESDs declared in this IOD.
- ii. IOD contained `IPMP_Descriptors` have scope within the given IOD only and shall not be referenced by subsequently declared IODs, ODs, streams nor available for updating via `IPMP_DescriptorUpdates`.
- iii. The IOD contained `IPMP_Descriptors` shall not be referenced by IODs, ODs, streams declared in IOD declared OD or Scene streams.

`toolListDescr` – a list of all IPMP tools required for the processing of the content. The array shall have zero or 1 element.

End Subclause 8.6.4.2 insertion

An additional stream type has been defined to carry IPMP tools in the content stream.

In Subclause 8.6.6.2, replace Table 9 with the following:

Table 9 - streamType Values

| streamType value | streamType description |
|-------------------------|-------------------------------|
| 0x00 | Forbidden |
| 0x01 | ObjectDescriptorStream |
| 0x02 | ClockReferenceStream |
| 0x03 | SceneDescriptionStream |
| 0x04 | VisualStream |
| 0x05 | AudioStream |
| 0x06 | MPEG7Stream |
| 0x07 | IPMPStream |
| 0x08 | ObjectContentInfoStream |
| 0x09 | MPEGJStream |
| 0x0A | InteractionStreamType |
| 0x0B | IPMPToolStream |
| 0x0C - 0x1F | reserved for ISO use |
| 0x20 - 0x3F | user private |

Insert the following text after Subclause 8.6.14.2.

IPMP Tool List Specification

For each tool, this includes

- 1) IPMP Tool Identifier
- 2) Optional Parametric Description of the Tool.
- 3) Alternative Tools to the given Tool, any one of which replace the others without loss of functionality.

The Tool List shall be in the IOD, in an `IPMP_ToolListDescriptor`. Binary IPMP Tools are carried in separate elementary streams associated with the IOD. The specification of the syntax for the Tool List is as follows.

The `IPMP_ToolListDescriptor` conveys the list of IPMP tools required to access the content associated with the `InitialObjectDescriptor` in which it is described, and may include a list of alternate IPMP tools or parametric descriptions of tools required to access the content.

IPMP_ToolListDescriptor

This Subclause defines syntax and semantics for the carriage of a list of IPMP Tools required for the processing of the presentation.

Syntax

```
class IPMP_ToolListDescriptor extends BaseDescriptor :  
    bit(8) tag= IPMP_ToolsListDescrTag  
{  
    IPMP_Tool ipmpTool[0 .. 255];  
}
```

Semantics

IPMP_Tool – a class describing a logical IPMP Tool required to access the content.

IPMP_Tool

The IPMP Tool Identifier (or **IPMP_ToolID**) is 128-bits long, and shall contain a unique identification number for the IPMP Tool. A registration authority for IPMP Tools that use a unique ID is required. The registration authority shall maintain an optional association of the download URLs for various implementations of the given tool for various platforms. These platforms will be described to adequate detail using a structured representation. The **IPMP_TOOLID** identifies a specific IPMP Tool (not a specific implementation of such a tool), unless in the reserved range for parametrically defined tools. Currently assigned 16-bit **IPMPS_Types** shall be directly mapped to a 128-bit ID by prepending with 112 zero bits; the RA will be initialized with such values. Specific values within this 128-bit space are reserved for indicating parametric tools, the bitstream, the terminal, and other special addresses. These values shall not be assigned to registered Tools.

Table Amd3-3 - Values of IPMP_ToolID

| IPMP_ToolID | Semantics |
|--------------------|---------------------------------------|
| 0x0000 | Forbidden |
| 0x0001 | Content |
| 0x0002 | Terminal |
| 0x0003 - 0x2000 | Reserved for ISO use |
| 0x2001 - 0xFFFF | Carry over from 14496-1 RA |
| 0x10000 - 0x100FF | Parametric Tools or Alternative Tools |
| 0x100FF - 2^128-2 | Open for registration |
| 2^128-1 | Forbidden |

Syntax

```

class IPMP_Tool extends BaseDescriptor {
    bit(8) tag= IPMP_ToolTag
{
    bit(128) IPMP_ToolID;
    bit(1) isAltGroup;
    bit(1) isParametric;
    const bit(6) reserved=0b0000.00;

    if(isAltGroup) {
        bit(8) numAlternates;
        bit(128) specificToolID[numAlternates];
    }
    if(isParametric)
        IPMP_ParamtericDescription toolParamDesc;
    ByteArray ToolURL[];
}

```

Semantics

Each instance of Class `IPMP_Tool` identifies one IPMP Tool that is required by the Terminal to Consume the Content. This Tool shall be specified either as a unique implementation, as one of a list of alternatives, or through a parametric description.

A unique implementation is indicated by the `isAltGroup` and `isParametric` fields both set to zero. In this case, the `IPMP_ToolID` shall be from the range reserved for specific implementations of an IPMP Tool and shall directly indicate the required Tool.

In all other cases, the `IPMP_ToolID` serves as a Content-specific abstraction for an IPMP Tool ID since the actual IPMP Tool ID of the Tool is not known at the time of authoring the Content, and will depend on the Terminal implementation at a given time for a given piece of Content.

A parametric description is indicated by setting the `isParametric` field to one. In this case, the Terminal shall select an IPMP Tool that meets the criteria specified in the following parametric description. In this case, the `IPMP_ToolID` shall be from the range reserved for Parametric Tools or Alternative Tools. The actual IPMP Tool ID of the Tool that the terminal implementation selects to fulfill this parametric description is known only to the Terminal. All the Content, and other tools, will refer to this Tool, for this Content, via the `IPMP_ToolID` specified. Note, this is not for message addressing.

A list of alternative Tools is indicated by setting the `isAltGroup` flag to "1". The subsequent specific Tool IDs indicate the Tools that are equivalent alternatives to each other. If the `isParametric` field is also set to one, any Tool that is selected under the conditions for parametric tools (as discussed in the paragraph above) shall be considered by the Terminal to be another equivalent alternative to those specified via specific Tool IDs. The Terminal shall choose one from these equivalent alternatives at its discretion. The actual IPMP Tool ID of this Tool is known only to the Terminal.

`IPMP_ToolID` – the identifier of the IPMP Tool, as discussed above.

`isAltGroup` – if set to one, this `IPMP_Tool` contains a list of alternate IPMP Tools.

`numAlternates` – the number of alternative IPMP Tools specified in `IPMP_Tool`.

`specificToolID` – an array of the IDs of specific alternative IPMP Tools that can allow consumption of the content.

`isParametric` – `IPMP_Tool` contains a parametric description of an IPMP Tool. In this case, `IPMP_ToolID` is an identifier for the parametrically described IPMP Tool, and the Terminal shall route information specified in the bitstream for `IPMP_ToolID` to the specific IPMP Tool instantiated by the terminal.

`ToolURL` – An array of informative URLs from which one or more tools specified in `IPMP_Tool` may be obtained in a manner defined outside the scope of these specifications.

IPMP_ParametricDescription

Using a parametric description, the content provider can now describe what type of IPMP tool is required to playback the content, instead of using fixed tool IDs. For example, the content provider can specify that an AES tool, with block size of 128 bits is required to decrypt video stream. The IPMP terminal, upon receiving such description specifying this tool, can then choose an optimised AES tool from the embedded tools.

This clause contains an illustration of the hierarchy that a parametric description would follow. It does not attempt to define any specific scheme for any specific Tool type. We anticipate that only a basic framework will appear in the current version of the specification, and enhancements to the same will be left for future addendums and/or versions.

1. Optional comment
2. Version of parametric description syntax
3. Class of Tool
 - e.g. Decryption, Rights Language Parser
4. Sub-class of Tool
 - a. e.g. for Decryption: AES, DES, NESSIE etc
 - b. e.g. for Watermarking: “Panos’s watermarking tool” etc
 - c. e.g. for Rights Language Parser: “Fred’s Rights Parser”
 - d. e.g. for Protocol Parser: “Mary’s Protocol Parser”
5. Sub-class-specific information
 - a. e.g. for DES: number of bits, stream and/or block decipher capability
 - b. e.g. for Rights Language Parser : version

The parametric description is defined to allow a generic description of any type of IPMP tool, no matter the type of tool.

Syntax

```
class IPMP_ParamtericDescription extends IPMP_Data_BaseClass:
bit(8) tag = IPMP_ParamtericDescription_tag = 0x10
{
    ByteArray      descriptionComment;
    bit(8)         majorVersion;
    bit(8)         minorVersion;
    Int i          numOfDescriptions;
    For (i = 0 to numOfDescriptions - 1){
        ByteArray class;
        ByteArray subClass;
        ByteArray typeData;
        ByteArray type;
        ByteArray addedData;
    }
}
```

Semantics

class - class of the parametrically described tool, for example, decryption.

subClass - sub-class of the parametrically described tool, for example, AES under decryption class.

typeData - specific type data to describe a particular type of tool, for example, Block_length, to further specify a AES decryption tool

`type` - value of the type data above, for example, 128 for the `Block_length`.

`addedData` - Any additional data which may help to further describe the parametrically defined tool.

ByteArray

This Subclause defines syntax and semantics to carry a generic string or array of bytes which is used extensively throughout the IPMP specifications.

Syntax

```
expandable class ByteArray
{
    bit(8) data[sizeOfInstance()];
}
```

Semantics

`data` - the string or array of bytes carried.

End text insertion after Subclause 8.6.14.2.

The extensions to the `IPMP_DescriptorPointer` support the extended ability to identify which specific IPMP stream or streams the IPMP tools declared in the corresponding `IPMP_Descriptor`, identified by the `IPMP_DescriptorIDEx`, wish to receive. Previously it was necessary for every single IPMP tool to reference a unique IPMP elementary stream to receive updates. With these extensions, multiple IPMP tools may receive updates from the same stream.

In Subclause 8.6.13.1, replace the syntax with the following text:

```
class IPMP_DescriptorPointer extends BaseDescriptor :
bit(8) tag = IPMP_DescRptrTag
{
    bit(8) IPMP_DescriptorID;
    if (IPMP_DescriptorID == 0xff){
        bit(16) IPMP_DescriptorIDEx;
        bit(16) IPMP_ES_ID;
    }
}
```

In Subclause 8.6.13.2, replace the semantics with the following text:

The `IPMP_DescriptorPointer` appears in the `ipmpDescPtr` section of an OD or ESD structures.

The presence of this descriptor in an object descriptor indicates that all streams referred to by embedded `ES_Descriptors` are subject to protection and management by the IPMP Tool specified in the referenced `IPMP_Descriptor`.

The presence of this descriptor in an `ES_Descriptor` indicates that the stream associated with this descriptor is subject to protection and management by the IPMP Tool specified in the referenced `IPMP_Descriptor`.

`IPMP_DescriptorID` is the ID of the `IPMP_Descriptor` being referred to. The `bit(8)` field is to support backward compatibility, for which support for extended IPMP stream association is not provided for.

`IPMP_DescriptorIDEx` is the ID of the `IPMP_Descriptor` being referred to. The `bit(16)` field refers to extension defined `IPMP_Descriptors` and also supporting the extended IPMP stream association.

`IPMP_ES_ID` is the id of an IPMP stream that may carry messages intended to the tool pointed to by `IPMP_DescriptorIDEx`. In case more than one IPMP stream is needed to feed the IPMP tool, several

`IPMP_DescriptorPointer` can be given with the same `IPMP_DescriptorIDEx` and different `IPMP_ES_ID`. If the `IPMP_ES_ID` is null, it means the IPMP tool does not require an IPMP stream. A value of $2^{16}-1$ for `IPMP_ES_ID` indicates that this field should be ignored, meaning that the tool pointed to by `IPMP_DescriptorIDEx` may receive messages from any IPMP stream within the presentation.

The list of IPMP streams identified by occurrences of the `IPMP_ES_ID` field (with a value different than $2^{16}-1$) for a single `IPMP_DescriptorIDEx` is exhaustive: the IPMP tool identified by the `IPMP_DescriptorIDEx` may not receive messages from any other IPMP streams than the ones identified in this list. In order to facilitate editing, the `IPMP_DescriptorPointer` must be modified when stored in a file: the `IPMP_ES_ID` field must be replaced with the corresponding index in the OD track's 'mpod' table as defined in ISO/IEC 14496-1:2001, Subclause 13.2.3.7.2.

In Subclause 8.6.14.1, replace the syntax with the following text:

```
class IPMP_Descriptor() extends BaseDescriptor : bit(8) tag = IPMP_DscrTag
{
    bit(8) IPMP_DescriptorID;
    unsigned int(16) IPMPS_Type;
    if (IPMP_DescriptorID == 0xFF && IPMPS_Type == 0xFFFF) {
        bit(16) IPMP_DescriptorIDEx;
        bit(128) IPMP_ToolID;
        bit(8) controlPointCode;
        if (controlPointCode > 0x00)
            bit(8) sequenceCode;
            IPMP_Data_BaseClass IPMPX_data[];
    }
    else if (IPMPS_Type == 0)
        bit(8) urlString[sizeOfInstance-3];
    else
        bit(8) IPMP_data[sizeOfInstance-3];
}
```

In Subclause 8.6.14.2, replace the semantics with the following text:

The `IPMP_Descriptor` carries IPMP information for one or more IPMP Tool instances. It shall also contain optional instantiation information for one or more IPMP Tool instances. `IPMP_Descriptors` are conveyed in either initial object descriptors, object descriptors or object descriptor streams via `IPMP_DescriptorUpdate` commands. Multiple definitions of the same `IPMP_Descriptor` within a single `IPMP_DescriptorUpdate` command or a single decoder specific information structure for an IPMP stream are not allowed. The behavior in such a situation is undefined. Note that, however, an `IPMP_Descriptor` may be modified/updated through subsequent `IPMP_DescriptorUpdate` commands received in the OD stream. `IPMP_Descriptors` shall be referenced by object descriptors or `ES_Descriptors`, using `IPMP_DescriptorPointer`.

`IPMP_DescriptorID` - a unique ID for this `IPMP_Descriptor` within its name scope. Values of "0x00" and "0xFF" are forbidden in the case of signaling an extension descriptor. The scope of the `IPMP_DescriptorID` is suggested to be the same as the OD, or IOD in which is it contained. `IPMP_DescriptorID` is for use in systems conforming to the previous definition as well as a signal indicating the use of `IPMP_DescriptorIDEx` for IPMP extensions.

NOTE Although it is possible to implement an application supporting both the use of IPMP protection schemes defined through the use of `IPMP_Descriptors` some of which contain `IPMP_DescriptorID` and some of which contain `IPMP_DescriptorIDEx` to protect separate streams, the behavior of the association of a single stream to both types of `IPMP_Descriptors` is undefined.

`IPMP_DescriptorIDEx` - a unique ID for this `IPMP_Descriptor` within its name scope. Values of "0x0000" and "0xFFFF" are forbidden. The scope of the `IPMP_DescriptorIDEx` is suggested to be the same as the OD, or IOD in which is it contained.

`IPMP_ToolID` – the `IPMP_ToolID` of the IPMP Tool described by this `IPMP_Descriptor`. A zero, "0" value does not correspond to an IPMP Tool but is used to indicate the presence of a URL.

`URLString[]` - contains a UTF-8 encoded URL that shall point to the location of a remote `IPMP_Descriptor`. If the `IPMPS_Type` of this `IPMP_Descriptor` is 0, another URL is referenced. This process continues until an `IPMP_Descriptor` with a non-zero `IPMPS_Type` is accessed.

`controlPointCode` – specifies the IPMP control point at which the IPMP Tool resides, and is one of the following values:

| controlPointCode | Description |
|-------------------------|---|
| 0x00 | No control point. |
| 0x01 | Control Point between the decode buffer and the decoder. This is between the decode buffer and class loader for MPEG-J streams. |
| 0x02 | Control Point between the decoder and the composition buffer. |
| 0x03 | Control Point between the composition buffer and the compositor. |
| 0x04 | BIFS Tree |
| 0x05-0xDF | ISO Reserved |
| 0xE0-0xFE | User defined |
| 0xFF | Forbidden |

NOTE The only difference between receiving composition units before the CB and after the CB in the MPEG-4 Systems decoder model is the order in which the units are received when the associated DTS is different from the CTS; in this case the decoding order is different from the composition order. For example, suppose that a watermark payload is embedded in more than a single video frame; if the watermark payload was embedded in decoding order, it has to be extracted before the CB; instead, if it was embedded in composition order, it has to be extracted after the CB.

NOTE For streams of type “0x01”, `ObjectDescriptor` and of type “0x02”, `ClockReferenceStream`, only a `controlPointCode` of “0x00”, “0x01” or the range “0xE0-0xFE” are meaningful.

`sequenceCode` - The higher the sequence code, the higher the sequencing priority of the IPMP Tool instance at the given control point. Thus the tool with the highest `sequenceCode` for a given control point on a given stream shall process data first for that control point for that stream. Two tools shall not have the same sequence number at the same control point for the same stream.

`IPMPX_data` - The IPMP data that is extended from `IPMP_Data_BaseClass`, for the given IPMP tool.

`IPMP_data` – Data of unspecified format.

In Subclause 8.8.1, replace the text:

“This Subclause specifies methods how to associate an IPMP system to an elementary stream or a set of elementary streams.”

with the text:

“This Subclause specifies methods to:

- a. Indicate IPMP Tools required for the processing of a given MPEG-4 presentation.
- b. Associate an IPMP System to an elementary stream or a set of elementary streams.
- c. Associate an IPMP Tool to a specified Control Point of an elementary stream or set of elementary Streams.
- d. Perform Mutual Authentication between IPMP Tools and between IPMP Tools and the Terminal.
- e. Request the instantiation of one or more IPMP Tools by another IPMP Tool.
- f. Request and receive notification of the instantiation of IPMP Tools.
- g. Provide a communication channel between IPMP Tools and the User.”

In Subclause 8.8.3, replace the entire text with:

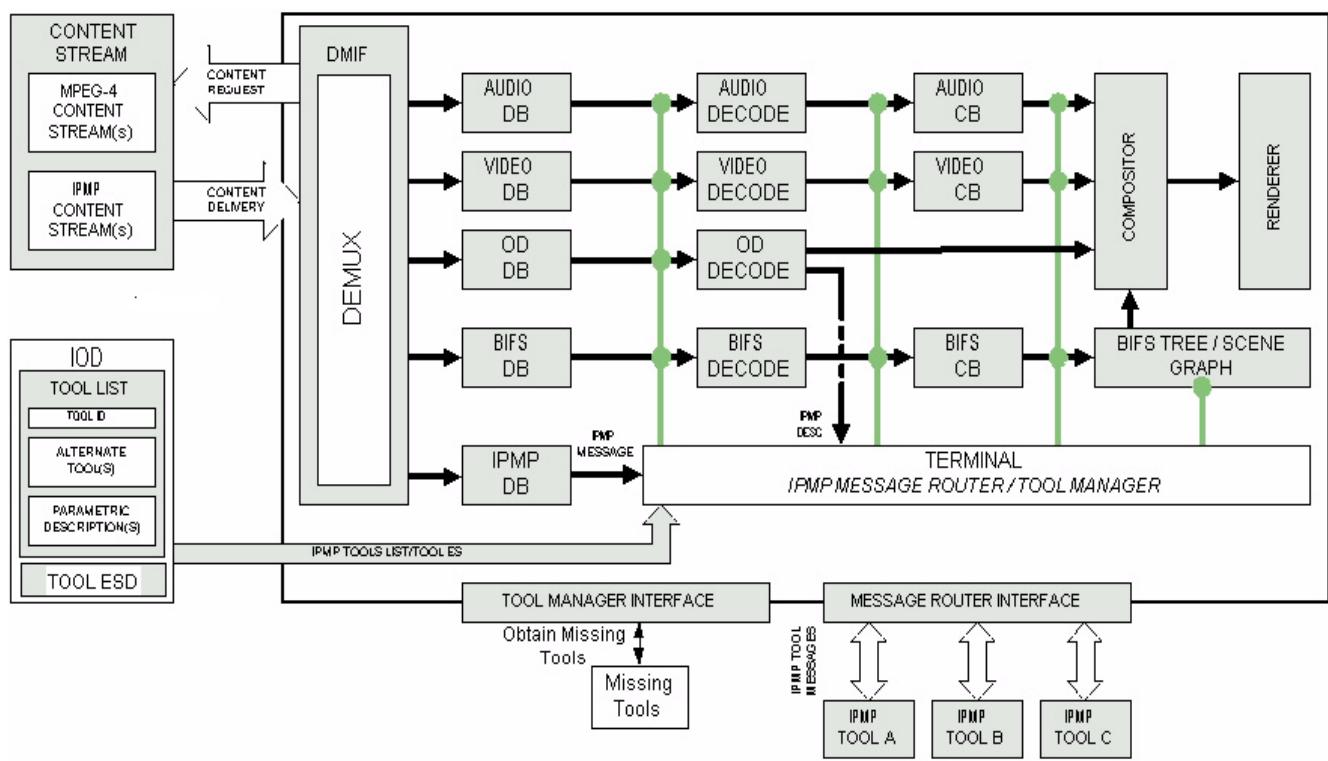
"Object Descriptor streams shall not be affected by IPMP Systems, i.e., they shall always be available without protection by IPMP Systems. However, management may be applied using IPMP Tools.

IPMP_Descriptors, which reference one or more IPMP Tools, may be directly included in an Object Descriptor for use by elementary streams referenced within the same Object Descriptor.

The scope of the IPMP_Descriptors included and used in this way is limited to only the Object Descriptor itself and the streams defined by reference within the Object Descriptor and may not be referenced by any subsequent descriptors which may be included in the streams referenced in the Object Descriptor.

Additionally, IPMP_Tools referenced in this way shall not receive updates either by IPMP Streams or IPMP descriptor updates."

In Subclause 8.8.6, replace the existing diagram with:



Add the following annexes after Annex W.

Annex X

(normative)

Selective Decryption Configuration Data

X.1 Introduction

The selective decryption configuration data is used to communicate to the decryptor, how the encryption of the received content bitstream is encrypted, whether all bits are encrypted or only portions of the received bits are encrypted. In the case when only portions of the received bits are encrypted, what portions of the received are encrypted and therefore need to be decrypted.

X.2 IPMP_SelectiveDecryptionInit

X.2.1 Syntax

```

class IPMP_SelectiveDecryptionInit extends IPMP_Data_BaseClass
: bit(8) tag = IPMP_SelectiveDecryptionInit_tag;
{
    bit(8) mediaTypeExtension;
    bit(8) mediaTypeIndication;
    bit(8) profileLevelIndication;
    bit(8) compliance;
    bit(8) numBufs;
    for(i=0, i<numBufs; i++)
        Struct bufInfoStruct {
            bit(128) cipher_Id;
            bit(8) syncBoundary;

            bit(1) isBlock;
            const bit(7) reserved = 0b0000.000;
            if(isBlock) {
                bit(8) mode;
                bit(16) blockSize;
                bit(16) keySize;
            } else {
                ByteArray Stream_Cipher_Specific_Init_Info;
            }
        }
    bit(1) isContentSpecific;
    const bit(7) reserved = 0b0000.000;
    if(isContentSpecific) {
        bit(8) numFields;
        for(i=0, i< numFields; i++) {
            Struct fieldStruct {
                bit(8) field_Id;
                bit(3) field_Scope;
                const bit(5) reserved = 0b0000.000;
                bit(8) buf;
                bit(1) isMapped;
                const bit(7) reserved = 0b0000.000;
                if(isMapped){
                    bit(1) sendMapTable;
                    bit(1) isShuffled;
                    const bit(6) reserved = 0b0000.000;
                    if(sendMapTable){
                        bit(16) sizeMapTable;
                    }
                }
            }
        }
    }
}

```

```

        bit(16) mappingTable[sizeMapTable]
    }
    if(isShuffled){
        ByteArray shuffleSpecificInfo;
    }
}
}
} else {
    bit(16) nSegments;
    bit(16) RLE_Data[nSegments]
}
}

```

X.2.2 Semantics

This message allows a terminal to configure a selective decryption tool.

mediaTypeExtension: extends mediaTypeIndication below; The following values are defined.

| mediaTypeExtension | Semantics |
|--------------------|--------------|
| 0x00 | ISO/IEC |
| 0x01 | ITU |
| 0x02 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

mediaTypeIndication: indication of format definition, e.g., MPEG-4 or MPEG-2 etc.; example values could be those of objectTypeIndication in 8.6.6 of ISO/IEC 14496-1.

profileLevelIndication: indication of profile/level of mediaTypeIndication; example values could be those of visualProfileLevelIndication in 8.6.4 of ISO/IEC 14496-1.

compliance: level of compliance to the compression format, i.e, the smallest logical unit in the encrypted bitstream that are correctly recognizable/parsable by the media decoder. For any non-compliant stream, the decryption tool will need to know what marker emulation prevention mechanism was deployed by the encryption tool. The method to emulation prevention is out of scope of this definition. The following values are defined.

| Compliance | Semantics |
|-------------|---|
| 0x00 | fully compliant |
| 0x01 | compliant to video packet level for video |
| 0x02 | compliant to VOP level for video |
| 0x03 | non-compliant for video |
| 0x04 | Compliant to GOB level for H.263 baseline |
| 0x05-2F | ISO Reserved for video |
| 0x30 | compliant to data frame level for AAC audio |
| 0x31 | non-compliant for AAC audio |
| 0x32 – 0x5F | ISO Reserved for audio |
| 0x60 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

numBufs: number of buffers needed to hold data to be decrypted separately. The cipher text will be demultiplexed into different buffers for separate decryption.

bufInfoStruct: a structure holding information needed for each buffer

cipher_Id: type of decryption algorithm used, e.g. , DES, 3DES, AES etc., registered through an RA.

syncBoundary: this field provides the tool information on what shall be considered a “unit of cipher-text”. Bits from different cipher-text unit are decrypted separately. The following values are defined.

| syncBoundary | Semantics |
|---------------------|--------------------------|
| 0x00 | Video packet for video |
| 0x01 | VOP (AU) for video |
| 0x02 | GOV for video |
| 0x03-2F | ISO Reserved for video |
| 0x30 | Data frame for AAC audio |
| 0x31 – 0x5F | ISO Reserved for audio |
| 0x60 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

isBlock: block or stream cipher.

mode: mode of block cipher, e.g., CBC, ECB, CFB, OFB, etc., registered through an RA [Annex AC].

blockSize: block size, in bytes, used for the block cipher

keySize: key size, in bytes, used for the block cipher.

stream_cipher_specific_init_info: normative initialization information if a stream cipher is specified by the cipher_Id.

The above data structures are for representing information pertaining to the buffers used for the decryption process. Below is information pertaining to the fields chosen for decryption.

isContentSpecific: a value of 0b1 indicates that the selective decryption is based on the selection of the fields. Otherwise RLE_Data will specify a collected range of the bitstream selected for decryption, using run length coding of this range information.

numFields: number of fields to be selected for decryption, e.g., MV, DC, DCTsign, Dquant, etc.

fieldStruct: a structure holding information about the fields chosen for decryption

field_Id: index of field based on a predefined list for the given syntax. The following values are defined.

| field_Id | Semantics |
|-------------|--|
| 0x00 | Motion vector (MV) for video |
| 0x01 | DC coefficients for video |
| 0x02 | DCT sign bits for video |
| 0x03 | Quantization parameter Dquant for video |
| 0x04 | DCT coefficients for video |
| 0x05 | All fields ie. All bits in a “unit of cipher text” |
| 0x06-2F | ISO Reserved for video |
| 0x30 | Sign bits for AAC audio |
| 0x31 | Run-length codewords for AAC audio |
| 0x32 | Scale factors for AAC audio |
| 0x32 – 0x5F | ISO Reserved for audio |
| 0x60 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

field_scope: represented in three bits, i.e., b2b1b0. A value of 0b1 for b2, b1, and b0 indicates that this field in I, P, and B VOPs, respectively, is selected and put into the buffer that it is associated with.

buf: which buffer this field will be put into.

isMapped: a value of 0b1 indicates that the codewords of a specific field will be mapped, using a mapping table, to an index which is then subject to decryption.

sendMapTable: a value of 0b1 indicates that the mapping table mappingTable will follow. Otherwise, the default mapping of the codeword table defined in the media format definition (e.g. MPEG4 video specification) is used.

sizeMapTable: size, number of entries of the mapping table.

mappingTable: entries of the mapping table. MappingTable[i] indicates that the *i*th codeword in the codeword table defined in the media format definition is mapped to the index of MappingTable[i].

isShuffled: a value of 0b1 indicates the mapped index sequence will be shuffled using a shuffling table specified in Shuffle_Specific_Info.

nSegments: number of disjoint segments that have been generated to signify which segments are selected for decryption

RLE_Data: specifies the number of bits that are to be decrypted or skipped interleavingly, starting from the first segment that is to be decrypted. If the first segment is not to be decrypted, then the value of the first entry shall be zero.

X.3 An example of a selective decryption configuration data (Informative)

One good example of using parametrically configured tools is a configurable selective encryption framework for securing MPEG-4 video content.

It is recognized that for some applications, simplistic, direct application of encryption to content bitstreams poses many problems, most often due to the lack of syntactic structure of the result. The complexity of encrypting the entire content bitstream can also be prohibitive for both very high bit rate content and low power devices. Selective encryption solves both of these problems, the latter due to the reduced complexity associated with only encrypting a portion of the stream and the former by designing the encryption method such that it results in a format compliant, yet encrypted stream. To achieve format compliance, the tool extracts bits from the fields that have been chosen for encryption, concatenates them in an appropriate way, encrypts the concatenation with a chosen cipher appropriate for the application, and then puts the encrypted bits back into their original positions. To maintain compliance, a fixed length index is assigned to each codeword in the VLC code table, and instead of encrypting the code word concatenation, the index concatenation is encrypted, and then the encrypted index concatenation is mapped back to codeword. Any pattern resulting from the encryption of index concatenation can be mapped back to a compliant codeword concatenation. FLC coded fields are treated as special cases of VLC, where the code length does not vary.

In MPEG IPMP extensions, the goal to define a standardized messaging framework between the tools and the terminal provides for an important functionality, namely that of a single configurable tool that could support a wide range of requirements and could be configured to apply only the subset of those that a particular application specified. Using the guidelines for field selection and tools for encrypting VLC in a syntax compliant way, this section illustrates an example of a selective decryption configuration message. It shall be noted that in designing these messages, it is assumed that the framework is intended to be applied to MPEG-4 video.

An example of a message is defined here that could be used to configure a format-compliant, selective decryption tool that implemented the method described above. The for-loops are unrolled, but the for-loop syntax is there so it is clear that repetition of various fields was a result of the logic in the data structures. This particular example message tells the decryption tool that it is working with a compliant bit stream. The tool will need two buffers, both of which will use DES as the decryption algorithm in CBC mode with a block size of 64 and a key length of 64. The fields will be grouped on a video packet basis. The fields involved will be MV, DC, DCT sign, and Dquant. The latter three are inserted into a buffer using the values that they take on in the bit stream, while the MVs are mapped to a set of 64 indices (known by the tool) and those are inserted in a separate buffer.

| Syntax field name | Syntactic Value | Semantic value | Bits |
|--|-----------------|--------------------------|------|
| | | | |
| mediaTypeExtension | 0 | ISO/IEC MPEG set | 8 |
| mediaTypeIndication | 32 | Visual ISO/IEC 14496-2 | 8 |
| (visual)profileLevelIndication | 3 | Simple Profile @ Level 1 | 8 |
| compliance | 0 | Bit-level compliant | 8 |
| numBufs | 2 | 2 buffers | 8 |
| /* For(i=0;i<numBufs;i++) */ | | | |
| /* numBufs=2 */ | | | |
| /* buffer 0: motion vectors */ | | | |
| cipher_Id | 0 | DES | 128 |
| syncBoundary | 0 | Video packet | 8 |
| isBlock | 1 | Block cipher | 1 |
| if(isBlock==1) { | | | |
| mode | 1 | CBC | 8 |
| blockSize | 64 | 64 | 16 |
| keySize | 64 | 64 | 16 |
| } | | | |
| /* i=1 buffer 1: DCT information buffer */ | | | |
| cipher_Id | 0 | DES | 128 |
| syncBoundary | 0 | Video packet | 8 |
| isBlock | 0 | Block cipher | 1 |
| if(isBlock==1) { | | | |
| mode | 1 | CBC | 8 |
| blockSize | 64 | 64 | 16 |
| keySize | 64 | 64 | 16 |
| } | | | |

| | | | |
|---|---|--------------------------------------|---|
| IsContentSpecific | 1 | Based on the selection of the fields | 1 |
| numFields | 4 | 4 fields for decryption | 8 |
| /* For(i=0;i<numFields;i++) /* numFields = 4 */ | | | |
| /* i=0, MV */ | | | |
| field_Id | 0 | 0 (MV) | 8 |
| field_scope | 2 | encrypt MVs for P frames | 3 |
| buf | 0 | 0 (mv buff) | 8 |
| isMapped | 1 | mapped | 1 |
| isShuffled | 0 | no shuffle of the index | 1 |
| sendMapTable | 0 | don't send mapping | 1 |
| /* i=1, DC */ | | | |
| field_Id | 1 | 1 (DC) | 8 |
| field_scope | 6 | encrypt DCs for I and P frames | 3 |
| buf | 1 | 1 (other buffer) | 8 |
| isMapped | 0 | not mapped | 1 |
| /* i=2, DCT sign */ | | | |
| field_Id | 2 | 2 (DCT sign) | 8 |
| field_scope | 6 | encrypt DCT signs for I and P frames | 3 |
| buf | 1 | 1 (other buffer) | 8 |
| isMapped | 0 | not mapped | 1 |
| /* i=3, Dquant */ | | | |
| field_Id | 3 | 3 (Dquant) | 8 |
| field_scope | 6 | encrypt Dquants for I and P frames | 3 |
| buf | 1 | 1 (other buffer) | 8 |
| isMapped | 0 | not mapped | 1 |

Annex Y (normative)

Audio Watermarking Configuration and Notification

Y.1 Introduction

This annex details two types of IPMP Data for audio watermarking. The **IPMP_AudioWatermarkingInit** Data is extended from **IPMP_Data_BaseClass**. It could be carried in either **IPMP_Descriptor** or **IPMP Stream**, and sent to a Watermarking Tool in order to initialize the process of insertion/extraction of the watermarking payload into/from an audio stream. The Watermarking Tool receives the audio stream and in case of watermarking extraction, constructs an **IPMP_SendAudioWatermark** data, either send it upstream, or informs the terminal with an **IPMP_MessageFromTool** message carrying the **IPMP_SendAudioWatermark** data.

This Annex provides means for facilitating audio watermarking technologies capable not only for insertion/extraction but also for remarking and perhaps the most important, distinguishing between legal from illegal audio material.

Y.2 IPMP_AudioWatermarkingInit

Y.2.1 Syntax

```
class IPMP_AudioWatermarkingInit extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_AudioWatermarkingInit_tag
{
    bit(8) inputFormat;
    bit(4) requiredOp;
    bit(1) hasOpaqueData;
    const bit(3) reserved = 0b000;

    if (inputFormat == PCM)
    {
        bit(8) nChannels;
        bit(8) bitPerSample;
        bit(32) frequency;
    }

    if ((requiredOp == INSERT_WM) || (requiredOp == REMARK_WM))
    {
        bit(16) wmPayloadLen;
        bit(8) wmPayload[wmPayloadLen];
    }

    if ((requiredOp == EXTRACT_WM) || (requiredOp == DETECT_COMPRESSION))
    {
        bit(16) wmRecipientId;
    }

    if (hasOpaqueData)
    {
        bit(16) opaqueDataSize;
        bit(8) opaqueData[opaqueDataSize];
    }
}
```

Y.2.2 Semantics

The IPMP_AudioWatermarkingInit data delivers to an audio watermarking tool all the information about the characteristics of the audio content, the type of action to be performed on it and, possibly other related proprietary data required by the watermarking tool. Furthermore in case of:

insertion, the watermarking payload to be inserted;

extraction, the ID of the recipient of the watermarking payload is provided;

remarking, the watermarking payload to be inserted;

compression detection, the ID of the recipient of the decision (that compression has taken place or not) is provided.

As an example of *compression detection*, considering that the audio material has been distributed only in a non-compressed legacy (CD) format, thus, if detected that compression took place on it, it will be unauthorised (pirated) content. This implies that the watermarking tool will be able to discriminate compression from other common signal processing manipulations which may also took place in the signal but are not considered prohibited (as expressed by the rights attached to the particular audio stream) such as sample rate conversion, tremble/bass, spatialisation, echo, etc. It should be clear that this is only an example of the possible usages of this flag. Its goal in general is to facilitate means and technologies for distinguishing legal from illegal audio content.

| | |
|---------------------|--|
| inputFormat | The format of the audio input stream, as indicated in a Table to be maintained by a registration authority. The Table shall contain at least the PCM format, signaled by the value "0x01" and all audio formats indicated in Table 8 "ObjectTypeIndication values" in [W3C recommendation, Extensible Markup Language (XML) 1.0 (2nd Edition)] |
| RequiredOp | The operation that the watermarking tool is required to perform on the audio stream. The following values are allowed: INSERT_WM = 0 EXTRACT_WM=1 REMARK_WM =2 DETECT_COMPRESSION =3 ISO reserved = 4..10 User defined = 11..15 |
| NChannels | the number of channels (1 = mono, 2 = stereo...) of the input stream |
| Frequency | the number of samples per second (in Hz. e.g. 44100) of the input stream |
| BitPerSample | the number of bits per sample (e.g. 8, 16) of the input stream |

| | |
|--------------------------|---|
| WmPayload | the watermarking payload to be inserted in the audio content |
| WmRecipientId | the destination tool identified by the IPMP_Descriptor_ID , to which the watermarking payload and compression information must be delivered. A value of 0x00 indicates the terminal. |
| HasOpaqueData | a flag that indicates if the message also carries opaque data information for the watermarking tool. |
| OpaqueContentSize | the length of the opaque data field in bytes |
| OpaqueData | the opaque data field carrying proprietary information to the watermarking tool (e.g. initialization parameters, like specific algorithm id, keys, etc.) |

Y.3 IPMP_SendAudioWatermark

Y.3.1 Syntax

```
class IPMP_SendAudioWatermark extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_SendAudioWatermark_tag
{
    bit(2) wm_status;
    bit(2) compression_status;
    bit(1) hasOpaqueData;
    bit(3) reserved = 0b000;
    if (wm_status == WM_PAYLOAD)
    {
        ByteArray payload;
    }
    if (hasOpaqueData)
    {
        ByteArray opaqueData;
    }
}
```

Y.3.2 Semantics

An audio watermarking tool, which has been required to perform payload extraction will construct this IPMP data, and either send it upstream, or wrap this IPMP data in IPMP_MessageFromTool message and send this message to **wmRecipientId** each time a new watermarking payload is extracted from the audio content.

An audio watermarking tool, which has been required to detect if compression has been taken place on a raw (PCM) audio stream, will construct this IPMP data, and either send it upstream, or wrap this IPMP data in IPMP_DescriptorFromBitstream message and send this message to **wmRecipientId** each time it detects that the raw audio stream has been either compressed (and as such perhaps has been illegally distributed) or not.

| | |
|--------------------|---|
| wm_status | the result of the check if watermarking was present. If watermark was detected, then this value also says if the payload extracted is carried inside the message or not. Possible values are listed in Table Y.1 below. |
| compression_status | the result of the check if the audio stream was compressed. Possible values are listed in Table Y.2 below. |
| hasOpaqueData | a flag indicating whether this message carries opaque data. |
| payload | the watermarking payload extracted from the audio content. |
| opaqueData | opaque data from the Watermarking Tool. |

Table Y.1: wm_status

| | | |
|----|--------------|---|
| 00 | WM_PAYLOAD | watermarking was present in the audio stream, payload is carried in the message. |
| 01 | WM_NOPAYLOAD | watermarking was present in the audio stream, no payload is carried in the message. |
| 10 | NO_WM | watermarking was not present in the audio stream. |
| 11 | WM_UNKNOWN | the Watermarking Tool was unable to detect whether watermarking was present in the audio stream or not. |

Table Y.2: compression_status

| | | |
|----|----------------|---|
| 00 | COMPRESSION | the audio stream was compressed |
| 01 | NO_COMPRESSION | the audio stream was not compressed |
| 10 | COMP_UNKNOWN | the Watermarking Tool was unable to detect if the audio stream was compressed |
| 11 | ISO Reserved | |

Annex Z (normative)

Video Watermarking Configuration and Notification Data

Z.1 Introduction

This annex details two types of IPMP Data for video watermarking. The **IPMP_VideoWatermarkingInit** Data is extended from **IPMP_Data_BaseClass**. It could be carried in either **IPMP_Descriptor** or **IPMP Stream**, and sent to a Video Watermarking Tool in order to initialize the process of insertion/extraction of the watermarking payload into/from an video stream. The Watermarking Tool receives the video stream and in case of watermarking extraction, constructs an **IPMP_SendVideoWatermark** data, either send it upstream, or informs the terminal with an **IPMP_MessageFromTool** message carrying the **IPMP_SendAudioWatermark** data.

This annex provides means for facilitating video watermarking technologies capable not only for insertion/extraction but also for remarking and perhaps the most important, distinguishing between legal from illegal video material.

Z.2 IPMP_VideoWatermarkingInit

Z.2.1 Syntax

```
class IPMP_VideoWatermarkingInit extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_VideoWatermarkingInit_tag
{
    bit(8) inputFormat;
    bit(4) requiredOp;
    bit(1) hasOpaqueData;
    const bit(3) reserved = 0b000;

    if (inputFormat == YUV)
    {
        bit(16) frame_horizontal_size;
        bit(16) frame_vertical_size;
        bit(8) chroma_format;
    }

    if ((requiredOp == INSERT_WM) || (requiredOp == REMARK_WM))
    {
        bit(16) wmPayloadLen;
        bit(8) wmPayload[wmPayloadLen];
    }

    if ((requiredOp == EXTRACT_WM) || (requiredOp == DETECT_COMPRESSION))
    {
        bit(16) wmRecipientId;
    }

    if (hasOpaqueData)
    {
        bit(16) opaqueDataSize;
        bit(8) opaqueData[opaqueDataSize];
    }
}
```

Z.2.2 Syntax

The IPMP_VideoWatermarkingInit data delivers to a watermarking tool all the information about the characteristics of the video content, the type of action to be performed on it and, possibly other related proprietary data required by the watermarking tool. Furthermore in case of:

insertion, the watermarking payload to be inserted;

extraction, the ID of the recipient of the watermarking payload is provided;

remarking, the watermarking payload to be inserted;

compression detection, the ID of the recipient of the decision (that compression has taken place or not) is provided.

| | |
|------------------------------|---|
| inputFormat | The format of the video input stream, as indicated in a Table to be maintained by a registration authority. The Table shall contain at least all video formats indicated in Table 8 "ObjectTypeIndication values" in [3] |
| RequiredOp | The operation that the watermarking tool is required to perform on the audio stream. The following values are allowed: INSERT_WM = 0 EXTRACT_WM = 1 REMARK_WM = 2 DETECT_COMPRESSION = 3 ISO reserved = 4..10 User defined = 11..15 |
| frame_horizontal_size | Horizontal size of the yuv frame |
| frame_vertical_size | vertical size of the yuv frame |
| chroma_format | chroma_format: 0x01=4:2:0, 0x02=4:2:2, 0x03=4:4:4 ISO reserved =0x04..0xA0 User defined = 0xA1..0xFE Forbidden: 0x00, 0xFF |
| WmPayloadLen | the length of the watermarking payload in bytes to be inserted in the video content. |
| WmPayload | the watermarking payload to be inserted in the video content |
| WmRecipientId | the destination tool identified by the IPMP_Descriptor_ID, to which the watermarking payload and compression information must be delivered. A value of 0x00 indicates the terminal. |

| | |
|-------------------|---|
| HasOpaqueData | a flag that indicates if the message also carries opaque data information for the watermarking tool. |
| OpaqueContentSize | the length of the opaque data field in bytes |
| OpaqueData | the opaque data field carrying proprietary information to the watermarking tool (e.g. initialisation parameters, like specific algorithm id, keys, etc.) |

Z.3 IPMP_SendVideoWatermark

Z.3.1 Syntax

```
class IPMP_SendVideoWatermark extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_SendVideoWatermark_tag
{
    bit(2) wm_status;
    bit(2) compression_status;
    bit(1) hasOpaqueData;
    bit(3) reserved = 0b000;
    if (wm_status == WM_PAYLOAD)
    {
        ByteArray payload;
    }
    if (hasOpaqueData)
    {
        ByteArray opaqueData;
    }
}
```

Z.3.2 Semantics

A video watermarking tool, which has been required to perform payload extraction will construct this IPMP data, and either send it upstream, or wrap this IPMP data in IPMP_MessageFromTool message and send this message to `wmRecipientId` each time a new watermarking payload is extracted from the video content.

A video watermarking tool, which has been required to detect if compression has been taken place on a raw video stream, will construct this IPMP data, and either send it upstream, or wrap this IPMP data in IPMP_MessageFromTool message and send this message to `wmRecipientId` each time it detects that the raw video stream has been either compressed (and as such perhaps has been illegally distributed) or not.

| | |
|--------------------|---|
| wm_status | the result of the check if watermarking was present. If watermark was detected, then this value also says if the payload extracted is carried inside the message or not. Possible values are listed in Table Z.1 below. |
| compression_status | the result of the check if the video stream was compressed. Possible values are listed in Table Z.2 below. |
| hasOpaqueData | a flag indicating whether this message carries opaque data. |
| Payload | the watermarking payload extracted from the video content. |
| OpaqueData | opaque data from the Watermarking Tool. |

Table Z.1 — *wm_status*

| | | |
|----|---------------------|---|
| 00 | WM_PAYLOAD | watermarking was present in the video stream, payload is carried in the message. |
| 01 | WM_NOPAYLOAD | watermarking was present in the video stream, no payload is carried in the message. |
| 10 | NO_WM | watermarking was not present in the video stream. |
| 11 | WM_UNKNOWN | the Watermarking Tool was unable to detect whether watermarking was present in the video stream or not. |

Table Z.2 — *compression_status*

| | | |
|----|-----------------------|---|
| 00 | COMPRESSION | the video stream was compressed |
| 01 | NO_COMPRESSION | the video stream was not compressed |
| 10 | COMP_UNKNOWN | the Watermarking Tool was unable to detect if the video stream was compressed |
| 11 | ISO Reserved | |

Annex AA (normative)

Tool/Content Transfer Messages Among Distributed IPMP Devices

AA.1 Introduction

This annex is normative only for devices that implement IPMP inter-device communication for the transfer of content and/or IPMP tools. This annex provides for an IPMP framework that is supported and operates outside the scope of MPEG-4 Systems.

AA.2 Addressing of distributed devices

To address different IPMP devices in a network domain, every IPMP device shall be assigned with a unique 128 bit deviceID. How the deviceID is assigned and maintained unique is an implementation issue.

AA.3 IPMP_DeviceMessageBase

AA.3.1 Syntax

```
Aligned(8) abstract expandable(2^28-1) class IPMP_DeviceMessageBase: bit(8) tag = 0
{
    bit(8) Version;
    bit(128) sender_deviceID;
    bit(128) recipient_deviceID;
}
```

AA.3.2 Semantics

IPMP_DeviceMessageBase is an expandable base class for IPMP Device to Device Messages. The extension tags are defined in Table AA.1.

Version indicates the version of syntax used in the messages and shall be set to 0x02.¹⁾

Sender_DeviceID indicates the device ID of the originator of the message.

Recipient_DeviceID indicates the device ID of the intended recipient of the message.

Table AA.1 - Tags for messages extending IPMP_DeviceMessageBase

| 8-bit Tag Value | Symbolic Name |
|-----------------|----------------------------|
| 0x00 | Forbidden |
| 0x01 | IPMP_MessageFromDevice_tag |
| 0x02 – 0xCF | ISO Reserved |
| 0xD0 – 0xFE | User Defined |
| 0xFF | Forbidden |

1) Version number 0x01 is reserved for IPMP_ToolMessageBase

Table AA.2 - Tags for device messages extending IPMP_Data_BaseClass

| 8-bit Tag Value | Symbolic Name |
|-----------------|-----------------------------------|
| 0x1D | IPMP_RequestContent_tag |
| 0x1E | IPMP_ResponseToContentRequest_tag |
| 0x1F | IPMP_ContentTransfer_tag |
| 0x20 | IPMP_RequestTool_tag |
| 0x21 | IPMP_ResponseToToolRequest_tag |
| 0x22 | IPMP_DeviceID_Notification_tag |
| 0x23 – 0x2F | User Defined |
| 0x30 – 0x3F | ISO Reserved |

AA.4 Device to Device IPMP Message

AA.4.1 IPMP_MessageFromDevice

AA.4.1.1 Syntax

```
class IPMP_MessageFromDevice extends IPMP_DeviceMessageBase:
    bit (8) tag = IPMP_MessageFromDevice_tag
{
    IPMP_Data_BaseClass message[1..255];
}
```

AA.4.1.2 Semantics

message – a container for IPMP_Data_BaseClass derived data, for example, the content/tool transfer messages defined below, or the mutual authentication data for secure content/tool transfer.

AA.4.1.3 Response

Received message dependant.

AA.5 Content Transfer Messages

AA.5.1 IPMP_RequestContent

AA.5.1.1 Syntax:

```
class IPMP_RequestContent extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_RequestContent_tag
{
    bit(128) ContentID;
    if (ContentID == 0)
        ByteArray opaqueData;
    bit(128) IPMP_DomainID;
}
```

AA.5.1.2 Semantics:

Content_ID – An identification number that identifies the requested content.

OpaqueData – Data to identify requested content.

`IPMP_Domain_ID` – Identifies the domain. Every IPMP compatible device within the same domain should obtain the same `Domain_ID` via some secure means from the operator, possible during the time of registration to the operator.

AA.5.1.3 Response:

`IPMP_ResponseToContentRequest`.

AA.5.2 IPMP_ResponseToContentRequest

AA.5.2.1 Syntax:

```
class IPMP_ResponseToContentRequest extends IPMP_Data_BaseClass :  
    bit(8) tag = IPMP_ResponseToContentRequest _tag  
{  
    bit(2) response;  
    const bit(6) reserved=0b0000.00;  
}
```

AA.5.2.2 Semantics:

Table AA.3 - Response Message for Content Request

| Response | Note |
|----------|-----------------------|
| 00 | Reserved |
| 01 | No Such content |
| 10 | Prohibit in Copy/Move |
| 11 | Approved |

AA.5.3 IPMP_ContentTransfer

AA.5.3.1 Syntax:

```
class IPMP_ContentTransfer extends IPMP_Data_BaseClass :  
    bit(8) tag = IPMP_ContentTransfer_tag  
{  
    bit(128) ContentID;  
    bit(8) Sequence;  
    bit(32) PayloadSize;  
    bit(8) Payload[PayloadSize];  
}
```

AA.5.3.2 Semantics:

`Sequence` – an 8 bit field indicates the sequence number of this payload, this enables the recipient device to re-form the content. It accumulates upon each `IPMP_ContentTransfer` message, and it is reset to 0 when it reaches 256.

To securely transfer the content, this entire message could be set as a payload of the `IPMP_SecureContainer` as defined in 8.3.2.7.3.

AA.5.3.3 Response:

Not required

AA.6 Tool Transfer Messages

AA.6.1 IPMP_RequestTool

AA.6.1.1 Syntax:

```
class IPMP_RequestTool extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_RequestTool_tag
{
    bit(128) ToolID;
    bit(128) IPMP_DomainID;
    ByteArray opaqueData;
}
```

AA.6.1.2 Semantics

OpaqueData – Data useful for the identification of an appropriate tool type or an indication of the requesting device's platform capability.

AA.6.1.3 Response:

IPMP_ResponseToToolRequest.

AA.6.2 IPMP_ResponseToToolRequest

AA.6.2.1 Syntax:

```
class IPMP_ResponseToToolRequest extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_ResponseToToolRequest_tag
{
    bit(128) ToolID;
    bit(2) response;
    bit(6) reserved = 0b0000.00;
    if (response==0b11)
    {
        bit(32) PayloadSize;
        bit(8) Payload[PayloadSize];
        bit(16) ToolDescriptionSize;
        bit(8) ToolDescription [ToolDescriptionSize];
    }
}
```

AA.6.2.2 Semantics:

Table AA.4 - Response Message for Tool Request

| Response | Note |
|----------|---------------------------|
| 00 | Reserved |
| 01 | No Such tool |
| 10 | Prohibit for transferring |
| 11 | Approved |

Payload – carries binary tool

ToolDescription – description of the binary tool

To securely transfer the tool, this entire message could be set as a payload of the IPMP_SecureContainer as defined in 8.3.2.7.3.

AA.6.2.3 Response:

Not required

AA.7 Device ID messages

For a device to know all other devices that are connected to it within the same network, the following message is used to broadcast its existence to all other device connected.

AA.7.1 IPMP_DeviceID_Notification Message

AA.7.1.1 Syntax:

```
class IPMP_DeviceID_Notification extends IPMP_Data_BaseClass :
    bit(8) tag = IPMP_DeviceID_Notification_tag
{
    bit(128) IPMP_DomainID;
    ByteArray OpaqueData[];
}
```

AA.7.1.2 Semantics:

IPMP_DomainID – The existing Domain ID or Domain ID to be assigned.

OpaqueData – Application dependant data.

NOTE The Sender_DeviceID and Recipient_DeviceID contained in the IPMP_DeviceMessageBase container of this message may be defined as needed to indicate newly connected devices.

AA.7.1.3 Response:

IPMP_DeviceID_Notification as needed.

Annex AB

(normative)

Schema for Terminal Platform

The XML schema for terminal platform specification supports the specification of CPU, memory, Operating system, virtual machine, etc. Two possible applications within the IPMP scope are:

- Based on the terminal platform XML schema, an IPMP terminal can describe what it is, what the CPU is, what the operating system is, whether there are any assistant hardwares, etc. The IPMP terminal can send the information to the remote site while trying to retrieve a missing IPMP tool. The remote site, after receiving the information, and XML schema parsing, can then decide which tool (a windows DLL or a Java Byte Code, for example) to send.
- Based on the terminal platform XML schema, an IPMP tool can also describe on what platform it can run, and carry the information in the metadata associated with the IPMP tool, or in the Tool ESD associated with a Tool ES. When receiving such an IPMP tool, an IPMP terminal can decide whether this tool can run on it.

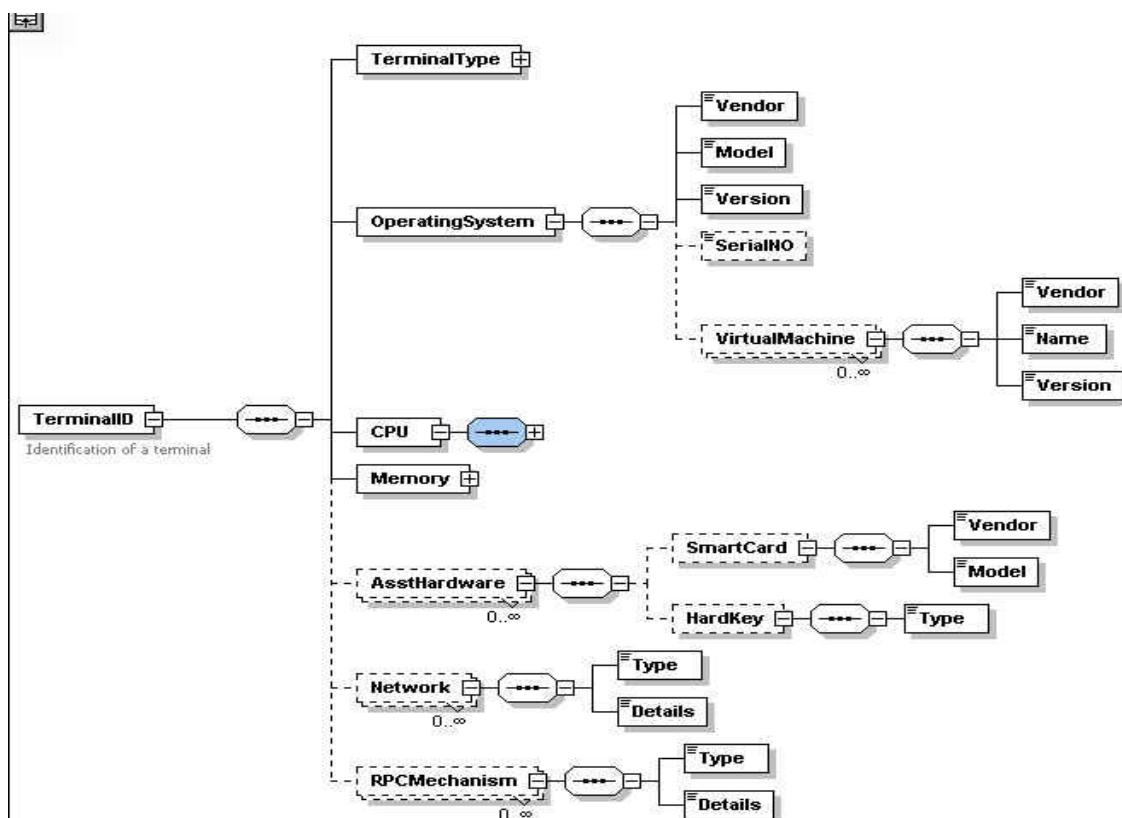


Figure AB.1 - Schema for Platform Representation

```

<?xml version="1.0" encoding="UTF-8" ?>

<xsd:schema targetNamespace="urn:mpeg:mpeg4:IPMPSchema:2002"
  xmlns:mpeg4ipmp="urn:mpeg:mpeg4:IPMPSchema:2002"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  elementFormDefault="qualified" attributeFormDefault="unqualified">

  <xsd:element name="TerminalID" type="mpeg4ipmp:TerminalIDType">
    <xsd:annotation>
      <xsd:documentation>Identification of a
        terminal</xsd:documentation>
    </xsd:annotation>
  </xsd:element>

  <xsd:complexType name="TerminalIDType">
    <xsd:sequence>
      <xsd:element name="TerminalType">
        <xsd:complexType>
          <xsd:sequence>
            <xsd:element name="Vendor" type="xsd:string" />
            <xsd:element name="Model" type="xsd:string" />
            <xsd:element name="SerialNO" type="xsd:string"
              minOccurs="0" />
          </xsd:sequence>
        </xsd:complexType>
      </xsd:element>
    </xsd:sequence>
  </xsd:complexType>

  <xsd:element name="OperatingSystem" type="mpeg4ipmp:OSType" />
  <xsd:element name="CPU" type="mpeg4ipmp:CPUType" />
  <xsd:element name="Memory" type="mpeg4ipmp:MemoryType" />
  <xsd:element name="AsstHardware" minOccurs="0"
    maxOccurs="unbounded">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="SmartCard" minOccurs="0">
          <xsd:complexType>
            <xsd:sequence>

```

```

        <xsd:element name="Vendor"
          type="xsd:string" />

        <xsd:element name="Model"
          type="xsd:string" />

      </xsd:sequence>

    </xsd:complexType>

  </xsd:element>

  <xsd:element name="HardKey" minOccurs="0">

    <xsd:complexType>

      <xsd:sequence>

        <xsd:element name="Type"
          type="xsd:string" />

      </xsd:sequence>

    </xsd:complexType>

  </xsd:element>

</xsd:sequence>

</xsd:complexType>

</xsd:element>

  <xsd:element name="Network" minOccurs="0"
    maxOccurs="unbounded">

    <xsd:complexType>

      <xsd:sequence>

        <xsd:element name="Type" type="xsd:string" />

        <xsd:element name="Details" type="xsd:string" />

      </xsd:sequence>

    </xsd:complexType>

  </xsd:element>

</xsd:sequence>

</xsd:complexType>

</xsd:element>

  <xsd:element name="Downloading" minOccurs="0"
    maxOccurs="unbounded">

    <xsd:complexType>

      <xsd:attribute name="Capability" type="xsd:boolean"
        use="required" />

    </xsd:complexType>

```

```

</xsd:element>

<xsd:element name="RPCMechanism" minOccurs="0"
  maxOccurs="unbounded">

  <xsd:complexType>
    <xsd:sequence>
      <xsd:element name="Type" type="xsd:string" />
      <xsd:element name="Details" type="xsd:string" />
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="Firmware" minOccurs="0"
  maxOccurs="unbounded">

  <xsd:complexType>
    <xsd:attribute name="Vendor" type="xsd:string"
      use="required" />
    <xsd:attribute name="Name" type="xsd:string"
      use="required" />
    <xsd:attribute name="Version" type="xsd:string"
      use="required" />
  </xsd:complexType>
</xsd:element>

</xsd:sequence>
</xsd:complexType>

<xsd:complexType name="OSType">

  <xsd:sequence>
    <xsd:element name="Vendor" type="xsd:string" />
    <xsd:element name="Model" type="xsd:string" />
    <xsd:element name="Version" type="xsd:string" />
    <xsd:element name="SerialNO" type="xsd:string" minOccurs="0"
      />
    <xsd:element name="VirtualMachine" minOccurs="0"
      maxOccurs="unbounded">

      <xsd:complexType>

```

```
<xsd:sequence>

    <xsd:element name="Vendor" type="xsd:string" />

    <xsd:element name="Name" type="xsd:string" />

    <xsd:element name="Version" type="xsd:string" />

</xsd:sequence>

</xsd:complexType>

</xsd:element>

</xsd:sequence>

</xsd:complexType>

<xsd:complexType name="CPUType">

    <xsd:sequence>

        <xsd:element name="Vendor" type="xsd:string" />

        <xsd:element name="Model" type="xsd:string" />

        <xsd:element name="Speed" type="xsd:integer" />

    </xsd:sequence>

</xsd:complexType>

<xsd:complexType name="MemoryType">

    <xsd:sequence>

        <xsd:element name="Vendor" type="xsd:string" />

        <xsd:element name="Model" type="xsd:string" />

        <xsd:element name="Size" type="xsd:integer" />

        <xsd:element name="Speed" type="xsd:integer" />

    </xsd:sequence>

</xsd:complexType>

</xsd:schema>
```

Annex AC (normative)

Registration Procedure

AC.1 Registered Data

This specification requires registration authorities for the following:

1. The IPMP_ToolID for a specific implementation of an IPMP Tool.
2. The Tool_Format_ID to describe platform information of an IPMP Tool in the Content.
3. The Tool_Package_ID to describe the packaging format of an IPMP Tool in the Content.
4. CertType used for indication of the type of a certificate.
5. regAlgOID used in AlgorithmDescriptor for mutual authentication.
6. cipher_Id used in Selective Decryption Configuration Data.
7. inputFormat used in Audio and Video Watermarking Configuration Data.
8. Instantiation_API_ID and Messaging_API_ID of an IPMP Tool in IPMP_ToolAPI_Config.

NOTE The list of registration authorities is common for both MPEG-2 IPMP and MPEG-4 IPMP Extension as specified in ISO/IEC 14496-13.

AC.2 Procedure for the request of Registered Data

Requesters of Registered data shall apply to the Registration Authority. Registration forms shall be available from the Registration Authority. The requester shall provide the information specified in AC.7. Companies and organizations are eligible to apply.

AC.3 Responsibilities of the Registration Authority

The primary responsibilities of the Registration Authority administrating the registration are outlined in this annex; certain other responsibilities may be found in the JTC 1 Directives. The Registration Authority shall:

- a) implement a registration procedure for application for a unique IPMP_ToolID in accordance with the JTC 1 Directives;
- b) implement a registration procedure for application for Tool_Format_ID in accordance with the JTC 1 Directives;
- c) implement a registration procedure for application for Tool_Package_ID in accordance with the JTC 1 Directives;
- d) implement a registration procedure for application for CertType in accordance with the JTC 1 Directives;
- e) implement a registration procedure for application for regAlgOID in accordance with the JTC 1 Directives;
- f) implement a registration procedure for application for cipher_Id in accordance with the JTC 1 Directives;
- g) implement a registration procedure for application for inputFormat in accordance with the JTC 1 Directives;

- h) implement a registration procedure for application for Instantiation_API_ID in accordance with the JTC 1 Directives;
- i) implement a registration procedure for application for Messaging_API_ID in accordance with the JTC 1 Directives;
- j) (a) through (i) above are expected to be either jointly registered or individually registered.
- k) (a) must be unique amongst each registration request whereas (b) through (i) are expected and encouraged to be reused wherever possible amongst requestors when appropriate.
- l) receive and process the applications for allocation of identifiers from application providers;
- m) ascertain which applications received are in accordance with this registration procedure, and to inform the requester within 30 days of receipt of the application of their assigned RID;
- n) inform application providers whose request is denied in writing within 30 days of receipt of the application, and to consider resubmissions of the application in a timely manner;
- o) maintain an accurate register of the allocated identifiers. Revisions to format specifications shall be accepted and maintained by the Registration Authority;
- p) make the contents of this register available upon request to National Bodies of JTC 1 that are members of ISO or IEC, to liaison organizations of ISO or IEC and to any interested party;
- q) maintain a data base of Registered Data request forms, granted and denied. Parties seeking technical information on the format of private data which has been registered shall have access to such information which is part of the data base maintained by the Registration Authority;
- r) report its activities annually to JTC 1, the ITTF, and the SC 29 Secretariat, or their respective designees;

AC.4 Contact information for the Registration Authority

To Be Determined

AC.5 Responsibilities of Parties Requesting Registered Data

The party requesting the registration of data shall:

- a) apply using the Form and procedures supplied by the Registration Authority;
- b) include a description of the purpose of the registered data, and the required technical details as specified in the application form;
- c) provide contact information describing how a complete description can be obtained on a non-discriminatory basis;
- d) agree to institute the intended use of the granted registered data within a reasonable time frame; and
- e) to maintain a permanent record of the application form and the notification received from the Registration Authority of registered data.

AC.6 Appeal Procedure for Denied Applications

The Registration Management Group is formed to have jurisdiction over appeals to denied request for registered data. The RMG shall have a membership who is nominated by P- and L-members of the ISO technical committee responsible for ISO/IEC 13818. It shall have a convenor and secretariat nominated from its members. The Registration Authority is entitled to nominate one non-voting observing member.

The responsibilities of the RMG shall be:

- a) to review and act on all appeals within a reasonable time frame;
- b) to inform, in writing, organizations which make an appeal for reconsideration of its petition of the RMGs disposition of the matter;
- c) to review the annual report of the Registration Authorities summary of activities; and
- d) to supply Member Bodies of ISO and National Committees of IEC with information concerning the scope of operation of the Registration Authority.

AC.7 Registration Application Form

AC.7.1 Contact Information of organization requesting a RID

Organization Name:

Address:

Telephone:

Fax:

E-mail:

Telex:

AC.7.2 Request for specific registered data

NOTE If the system has already been implemented and is in use, fill in this item and item AC.7.3 and skip to AC.7.5, otherwise leave this space blank and skip to AC.7.3.

AC.7.3 Short description of the Registered Data that is in use and date system was implemented

AC.7.4 Statement of an intention to apply the assigned Registered Data

AC.7.5 Date of intended implementation of the Registered Data

AC.7.6 Authorized representative

Name:

Title:

Address:

Email:

Signature _____

AC.7.7 For official use of the Registration Authority

Registration Rejected _____

Reason for rejection of the application:

Registration Granted _____

Registration Value _____

Attachment 1 — Attachment of technical details of the registered data format.

Attachment 2 — Attachment of notification of appeal procedure for rejected applications.

Annex AD (normative)

Patent statements

The International Organization for Standardization and the International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this part of ISO/IEC 14496 may involve the use of patents.

ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent rights have assured the ISO and IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patents right are registered with ISO and IEC. Information may be obtained from the companies listed below.

ContentGuard, Inc., 65000 Rock Spring Drive, Suite 110, Bethesda, MD 20817, USA.

Central Research Laboratories Ltd., Dawley Road, Hayes, Middlesex, UB3 1HH, UK.

Digimarc Corporation, 19801 SW 72nd Ave., Suite 250, Tualatin, OR 97062, USA.

IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504, USA.

Intellectual Property Rights Operations Company, Matsushita Electric Industrial Co., Ltd., 1-3-7, Shiromi, Chuoh-Ku, Osaka 540-6319, Japan.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 14496 may be the subject of patent rights other than those identified in this annex. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

End annex additions.

Add the following after Annex AD.

Bibliography

- [1] *A format compliant configurable encryption framework for access control of multimedia*, J. Wen et al, to appear in *IEEE Workshop on Multimedia Signal Processing*, Oct. 2001.
- [2] W3C working draft, *XML Schema Part 0: Primer*, <http://www.w3.org/TR/2000/WD-xmlschema-0-20000407/>, 7 April 2000

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Part 1: Systems

**AMENDMENT 4: SL extensions and
AFX streams**

Technologies de l'information — Codage des objets audiovisuels —

Partie 1: Systèmes

AMENDEMENT 4: Extensions SL et cours AFX

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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.

Amendment 4 to ISO/IEC 14496-1:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Information technology — Coding of audio-visual objects —

Part 1: Systems

AMENDMENT 4: SL extensions and AFX streams

In subclause 8.2.1, replace Table 1 - List of Class Tags for Descriptors, by the following:

Table 1 - List of Class Tags for Descriptors

| Tag value | Tag name |
|-----------|-------------------------------------|
| 0x00 | Forbidden |
| 0x01 | ObjectDescrTag |
| 0x02 | InitialObjectDescrTag |
| 0x03 | ES_DescrTag |
| 0x04 | DecoderConfigDescrTag |
| 0x05 | DecSpecificInfoTag |
| 0x06 | SLConfigDescrTag |
| 0x07 | ContentIdentDescrTag |
| 0x08 | SupplContentIdentDescrTag |
| 0x09 | IPI_DescrPointerTag |
| 0x0A | IPMP_DescrPointerTag |
| 0x0B | IPMP_DescrTag |
| 0x0C | QoS_DescrTag |
| 0x0D | RegistrationDescrTag |
| 0x0E | ES_ID_IncTag |
| 0x0F | ES_ID_RefTag |
| 0x10 | MP4_IOD_Tag |
| 0x11 | MP4_OD_Tag |
| 0x12 | IPL_DescrPointerRefTag |
| 0x13 | ExtensionProfileLevelDescrTag |
| 0x14 | profileLevelIndicationIndexDescrTag |
| 0x15-0x3F | Reserved for ISO use |
| 0x40 | ContentClassificationDescrTag |
| 0x41 | KeyWordDescrTag |
| 0x42 | RatingDescrTag |
| 0x43 | LanguageDescrTag |
| 0x44 | ShortTextualDescrTag |
| 0x45 | ExpandedTextualDescrTag |
| 0x46 | ContentCreatorNameDescrTag |
| 0x47 | ContentCreationDateDescrTag |
| 0x48 | OCICreatorNameDescrTag |
| 0x49 | OCICreationDateDescrTag |

| | |
|-----------|---------------------------------------|
| 0x4A | SmpteCameraPositionDescrTag |
| 0x4B | SegmentDescrTag |
| 0x4C | MediaTimeDescrTag |
| 0x4D-0x5F | Reserved for ISO use (OCL extensions) |
| 0x60-0x61 | Reserved for ISO use |
| 0x62 | FLEXmuxTimingDescrTag |
| 0x63 | FLEXmuxCodeTableDescrTag |
| 0x64 | ExtSLConfigDescrTag |
| 0x65 | FLEXmuxBufferSizeDescrTag |
| 0x66 | FLEXmuxIdentDescrTag |
| 0x67 | DependencyPointerTag |
| 0x68 | DependencyMarkerTag |
| 0x69 | FLEXmuxChannelDescrTag |
| 0x6A-0xBF | Reserved for ISO use |
| 0xC0-0xFE | User private |
| 0xFF | Forbidden |

In 8.6.4.2, replace Table 3 by:

Table 3 - ODProfileLevelIndication Values

| Value | Profile | Level |
|-----------|--|-------|
| 0x00 | Forbidden | - |
| 0x01 | Reserved for ISO use (no SL extension) | - |
| 0x02-0x7F | Reserved for ISO use (SL extension) | - |
| 0x03-0x7F | Reserved for ISO use | |
| 0x80-0xFD | user private | - |
| 0xFE | No OD profile specified | - |
| 0xFF | No OD capability required | - |

Note – 0x01 also indicates that the SL extension mechanism is not present ."

Replace 8.6.5.1 ESDescriptor syntax by:

```

class ES_Descriptor extends BaseDescriptor : bit(8) tag=ES_DescrTag {
    bit(16) ES_ID;
    bit(1) streamDependenceFlag;
    bit(1) URL_Flag;
    bit(1) OCRstreamFlag;
    bit(5) streamPriority;
    if (streamDependenceFlag)
        bit(16) dependsOn_ES_ID;
    if (URL_Flag) {
        bit(8) URLlength;
        bit(8) URLstring[URLlength];
    }
    if (OCRstreamFlag)
        bit(16) OCR_ES_Id;
    DecoderConfigDescriptor decConfigDescr;
    if (ODProfileLevelIndication==0x01)           //no SL extension.
    {
        SLConfigDescriptor slConfigDescr;
    }
    else                                         // SL extension is possible.
    {
        SLConfigDescriptor slConfigDescr;
    }
    IPI_DescrPointer ipiPtr[0 .. 1];
    IP_IdentificationDataSet ipIDS[0 .. 255];
    IPMP_DescriptorPointer ipmpDescrPtr[0 .. 255];
    LanguageDescriptor langDescr[0 .. 255];
    QoS_Descriptor qosDescr[0 .. 1];
    RegistrationDescriptor regDescr[0 .. 1];
    ExtensionDescriptor extDescr[0 .. 255];
}

```

In 8.6.5.2, replace:

slConfigDescr – is an SLConfigDescriptor as specified in 8.6.8.

by

slConfigDescr – is an SLConfigDescriptor as specified in 8.6.8. If ODProfileLevelIndication is different from 0x01, it may be an extension of SLConfigDescriptor (i.e. and extended class) as defined in 8.6.8.

In subclause 8.6.6.2: Semantics (of 8.6.6 DecoderConfigDescriptor), replace Table 8 - objectTypeIndication Values, with the following:

Table 8 - objectTypeIndication Values

| Value | ObjectTypeIndication Description |
|-------------|--|
| 0x00 | Forbidden |
| 0x01 | Systems ISO/IEC 14496-1 ^a |
| 0x02 | Systems ISO/IEC 14496-1 ^b |
| 0x03 | Interaction Stream |
| 0x04 | Systems ISO/IEC 14496-1 Extended BIFS Configuration ^c |
| 0x05 | Systems ISO/IEC 14496-1 AFX ^d |
| 0x06-0x1F | reserved for ISO use |
| 0x20 | Visual ISO/IEC 14496-2 ^e |
| 0x21-0x3F | reserved for ISO use |
| 0x40 | Audio ISO/IEC 14496-3 ^f |
| 0x41-0x5F | reserved for ISO use |
| 0x60 | Visual ISO/IEC 13818-2 Simple Profile |
| 0x61 | Visual ISO/IEC 13818-2 Main Profile |
| 0x62 | Visual ISO/IEC 13818-2 SNR Profile |
| 0x63 | Visual ISO/IEC 13818-2 Spatial Profile |
| 0x64 | Visual ISO/IEC 13818-2 High Profile |
| 0x65 | Visual ISO/IEC 13818-2 422 Profile |
| 0x66 | Audio ISO/IEC 13818-7 Main Profile |
| 0x67 | Audio ISO/IEC 13818-7 LowComplexity Profile |
| 0x68 | Audio ISO/IEC 13818-7 Scaleable Sampling Rate Profile |
| 0x69 | Audio ISO/IEC 13818-3 |
| 0x6A | Visual ISO/IEC 11172-2 |
| 0x6B | Audio ISO/IEC 11172-3 |
| 0x6C | Visual ISO/IEC 10918-1 |
| 0x6D - 0xBF | reserved for ISO use |
| 0xC0 - 0xFE | user private |
| 0xFF | no object type specified ^g |

^a This type is used for all 14496-1 streams unless specifically indicated to the contrary. Scene Description scenes, which are identified with StreamType=0x03 (see Table 7), using this object type value shall use the BIFSConfig specified in subclause 9.3.5.2.2 of this specification.

^b This object type shall be used, with StreamType=0x03 (see Table 7), for Scene Description streams that use the BIFSV2Config specified in subclause 9.3.5.3.2 of this specification. Its use with other StreamTypes is reserved.

^c This object type shall be used, with StreamType=0x03 (see Table 7), for Scene Description streams that use the BIFSConfigEx specified in subclause 8.7.6.1.2 of this specification. Its use with other StreamTypes is reserved.

^d This object type shall be used, with StreamType=0x03 (see Table 7), for Scene Description streams that use the AFXConfig specified in subclause 8.7.6.1.2 of this specification. Its use with other StreamTypes is reserved.

^e Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-2 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-2, Annex K.

^f Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-3 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-3 subpart 1 subclause 6.2.1.

^g Streams with this value with a StreamType indicating a systems stream (values 1,2,3, 6, 7, 8, 9) shall be treated as if the ObjectTypeIndication had been set to 0x01.

Append to 8.6.7.2:

For values of `DecoderConfigDescriptor.objectTypeIndication` that refers to extended BIFS configuration (0x04), the decoder specific information is:

```
class BIFSConfigEx extends DecoderSpecificInfo : bit (8) tag = DecSpecificInfoTag
{
    ExtendedBIFSConfig extBIFSConfig;
}

abstract aligned(8) expandable (...) class ExtendedBIFSConfig : bit (8) tag = 0x01..0xFF {
    //empty. To be filled by classes extending this class.
}
```

The class `BIFSConfigEx` contains an `ExtendedBIFSConfig`. `ExtendedBIFSConfig` is the base class for new classes meant to hold decoder specific information. With this approach, new BIFS streams will have `streamType` 3 and `objectTypeIndication` 3, but will use decoder configuration depending on the tag of the `ExtendedBIFSConfig`.

For values of `DecoderConfigDescriptor.objectTypeIndication` that refers to AFX streams (0x05), the decoder specific information is:

```
class AFXConfig extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {
    AFXExtDescriptor afxext;
}

abstract class AFXExtDescriptor extends BaseDescriptor : bit(8) tag = 0..100
{}
```

`AFXExtDescriptor` is an abstract class used as a placeholder for an optional `DecoderSpecificInfo` defined in this specification:

Table AMD4-1 — DecoderSpecificInfo for AFX streams

| AFX stream | DecoderSpecificInfo |
|---------------------------|--|
| MeshGrid | See subclause 5.2.2.2 of ISO/IEC 14496-16. |
| WaveletSubdivisionSurface | See subclause 5.1.1.1 of ISO/IEC 14496-16. |
| Other AFX streams | None |

and the tag refers to a specific node compression scheme as defined in Table AMD4-2.

Table AMD4-2 — AFX object code

| AFX object code | object |
|-----------------|---------------------------|
| 0x00 | 3D Mesh Compression |
| 0x01 | WaveletSubdivisionSurface |
| 0x02 | MeshGrid |
| 0x03 | CoordinateInterpolator |
| 0x04 | OrientationInterpolator |
| 0x05 | PositionInterpolator |
| 0x06 | OctreeImage |

In 10.2.3.1, append at the end of the subclause:

```
class ExtendedSLConfigDescriptor extends SLConfigDescriptor : bit(8)
tag=ExtSLConfigDescrTag {
    SLExtensionDescriptor slestDescr[1..255];
}
```

Append to 10.2.3.2:

slestDescr – is an array of ExtensionDescriptors defined for ExtendedSLConfigDescriptor as specified in 10.2.3.3.

Insert new subclause 10.2.3.3 SLExtensionDescriptor syntax:

```
abstract class SLExtensionDescriptor : bit(8) tag=0 {

class DependencyPointer extends SLExtensionDescriptor: bit(8) tag= DependencyPointerTag {
    bit(6) reserved;
    bit(1) mode;
    bit(1) hasESID;
    bit(8) dependencyLength;
    if (hasESID)
    {
        bit(16) ESSID;
    }
}
class MarkerDescriptor extends SLExtensionDescriptor: bit(8) tag=DependencyMarkerTag {
    int(8) markerLength;
}
```

Insert new subclause 10.2.3.4 SLExtensionDescriptor semantics:

SLExtensionDescriptor is an abstract class specified so as to be the base class of sl extensions.

10.2.3.4.1 DependencyPointer semantics

DependencyPointer extends SLExtensionDescriptor and specifies that access units from this stream depend on another stream.

If mode equals 0, the latter stream can be identified through the ESSID field or if no ESSID is present, using the dependsOn_ES_ID ESSID, and access units from this stream will point to the decodingTimeStamps of that stream.

If mode equals 1, access units from this stream will convey identifiers, for which the system (e.g. IPMP tools) are responsible to know whether dependent resources (e.g. keys) are available.

In both cases, the length of this pointer or identifier is dependencyLength.

If mode is 0 then dependencyLength shall be the length of the decodingTimeStamp.

10.2.3.4.2 MarkerDescriptor semantics

MarkerDescriptor extends SLExtensionDescriptor and allows to tag access units so as to be able to refer to them independently from their decodingTimeStamp.

markerLength – is the length for identifiers tagging access units.

Replace 10.2.4.1 with:

```

aligned(8) class SL_PacketHeader (SLConfigDescriptor SL) {
    if (SL.useAccessUnitStartFlag)
        bit(1) accessUnitStartFlag;
    if (SL.useAccessUnitEndFlag)
        bit(1) accessUnitEndFlag;
    if (SL.OCRLength>0)
        bit(1) OCRflag;
    if (SL.useIdleFlag)
        bit(1) idleFlag;
    if (SL.usePaddingFlag)
        bit(1) paddingFlag;
    if (paddingFlag)
        bit(3) paddingBits;

    if (!idleFlag && (!paddingFlag || paddingBits!=0)) {
        if (SL.packetSeqNumLength>0)
            bit(SL.packetSeqNumLength) packetSequenceNumber;
        if (SL.degradationPriorityLength>0)
            bit(1) DegPrioflag;
        if (DegPrioflag)
            bit(SL.degradationPriorityLength) degradationPriority;
        if (OCRflag)
            bit(SL.OCRLength) objectClockReference;

        if (accessUnitStartFlag) {
            if (SL.useRandomAccessPointFlag)
                bit(1) randomAccessPointFlag;
            if (SL.AU_seqNumLength >0)
                bit(SL.AU_seqNumLength) AU_sequenceNumber;
            if (SL.useTimeStampsFlag) {
                bit(1) decodingTimeStampFlag;
                bit(1) compositionTimeStampFlag;
            }
            if (SL.instantBitrateLength>0)
                bit(1) instantBitrateFlag;
            if (decodingTimeStampFlag)
                bit(SL.timeStampLength) decodingTimeStamp;
            if (compositionTimeStampFlag)
                bit(SL.timeStampLength) compositionTimeStamp;
            if (SL.AU_Length > 0)
                bit(SL.AU_Length) accessUnitLength;
            if (instantBitrateFlag)
                bit(SL.instantBitrateLength) instantBitrate;
        }
        if (SL.tag == ExtSLConfigDescrTag)
        {
            for (int i=0; i<SL.slextDescr.length;i++)
            {
                switch(SL.slextDescr[i].tag)
                {
                    case DependencyPointerTag:
                        Marker value(SL.slextDescr[i].dependencyLength);
                        break;
                    case DependencyMarkerTag:
                        Marker value(SL.slextDescr[i].markerLength);
                        break;
                    default:
                        break;
                }
            }
        }
    }
}

aligned expandable class Marker(int length) {
    bit(length) value;
}

```

Append to 10.2.4.2:

If the SLConfigDescriptor is an ExtendedSLConfigDescriptor (i.e. its tag is ExtSLConfigDescrTag), then descriptors associated with the array of SLExtensionDescriptors are appended to the end of the SLpacket Header.

Note – Since those descriptors conveying the extended SL information; carry their size, they can be skipped by a decoder.

DependencyPointerDescriptor and MarkerDescriptor define their associated descriptors as follows:

For DependencyPointerDescriptor a Marker of length dependencyLength will be encoded. It shall resolve either to an identifier or to a decodingTimeStamp as specified in 10.2.3.4.1.

For MarkerDescriptor a marker of length markerLength is encoded.

Replace subclause 12.2.4 with the following:

12.2.4 FlexMux packet specification

12.2.4.1 Syntax

```
class FlexMuxPacket (MuxCodeTableEntry mct[],
                     FlexMuxTimingDescriptor FM,
                     FlexMuxIDDescriptor mde) {
    unsigned int(8) index;
    if (mde == NUL || mde.Muxtype == 0) {
        bit(8) length;
    } else if (mde.Muxtype == 1) {
        length = 0;
        bit(1) nextByte;
        bit(7) length;
        while(nextByte) {
            bit(1) nextByte;
            bit(7) sizeByte;
            length = length<<7 | sizeByte;
        }
    }
    if (index<238) {
        if (length!=0) {
            SL_Packet sPayload;
        } else {
            bit(5) FMC_version_number;
            const bit(3) reserved=0b111;
        }
    } else if (index == 238) {
        bit(FM.FCR_Length) fmxClockReference;
        bit(FM.fmxRateLength) fmxRate;
        for (i=0; i<(length-FM.FCR_Length-FM.fmxRateLength); i++) {
            FlexMux_descriptor()
        }
    } else if (index == 239) {
        bit(8) stuffing[length];
    } else {
        bit(4) version;
        const bit(4) reserved=0b1111;
        multiple_SL_Packet mPayload(mct[index-240]);
    }
}
```

12.2.4.2 Semantics

length – the length of the FlexMux packet payload in bytes. This is equal to the length of the single encapsulated SL packet in Simple Mode and to the total length of the multiple encapsulated SL packets in MuxCode Mode. If the FlexMuxIDDescriptor is not used, or if it is used and if the Muxtype is designing the first FlexMux tool, the length field is on one byte. If the FlexMuxIDDescriptor is used and if the Muxtype is designing the second FlexMux tool, the length calculation relies on the combination of the nextByte and sizeByte fields that can be spread over several bytes. In Simple Mode, when this length is equal to zero, the FlexMux packet carries one byte that contains the FMC_version_number field. In Simple Mode, FlexMux packets with a length equal to zero (each carrying a FMC_version_number) can be duplicated.

FMC_version_number – This 5 bit field indicates the current version of the FLEXmuxChannelDescriptor that is applicable. FMC_version_number is used for error resilience purposes. If this version number does not match the version of the referenced FLEXmuxChannelDescriptor that has most recently been received, the following FlexMux packets belonging to the same FlexMux Channel cannot be parsed. The implementation is free to either wait until the required version of FLEXmuxChannelDescriptor becomes available or to discard the following FlexMux packets belonging to the same FlexMux Channel. In Simple Mode, the value given to the FMC_version_number field is identical in subsequent duplicated FlexMux packets with a length equal to zero.

Replace subclause 12.2.6 with the following:

12.2.6 Configuration and usage of FlexMux clock references

12.2.6.1 Syntax

```
aligned(8) class FlexMuxTimingDescriptor {
    bit(16) FCR_ES_ID;
    bit(32) FCRResolution;
    bit(8) FCRLength;
    bit(8) FmxRateLength;
}
```

12.2.6.2 Semantics

The sequence of fmxClockReference time stamps in a FlexMux stream constitutes a clock reference stream, albeit with a different syntax as specified in clause 10. Elementary streams shall be associated to the time base established by this clock reference by referencing the FCR_ES_ID as their OCR_ES_ID in the SLConfigDescriptor. The transport of the FlexMuxTimingDescriptor shall be defined during the design of the transport protocol stack that makes use of the FlexMux tool.

Insert subclause 12.2.10:

12.2.10 FlexMuxID Descriptor

12.2.10.1 Syntax

```
aligned(8) class FlexMuxIDDescriptor {
    bit(8) MuxID;
    bit(4) Muxtype;
    bit(4) Muxmanagement;
}
```

12.2.10.2 Semantics

MuxID – the ID of the FlexMux stream.

Muxtype – the type of the Multiplexing tool used to generate the FlexMux stream.

Indicated type value shall comply with the following AMD4-3 — Multiplexing type table.

Muxmanagement – the mode of management used by the Multiplexing tool, to generate the Flexmux stream.
Indicated mode value shall comply with the AMD4-4 — Multiplexing management mode table.

Table AMD4-3 — Multiplexing type table

| Type | Multiplexing tool |
|------|--------------------------|
| 0 | FlexMux tool |
| 1 | FlexMux_2 tool |
| 2-7 | ISO/IEC 14496-1 Reserved |
| 8-15 | User Private |

Table AMD4-4 — Multiplexing management mode table

| Type | management mode |
|------|--------------------------|
| 0 | Static |
| 1 | Dynamic |
| 2-7 | ISO/IEC 14496-1 Reserved |
| 8-15 | User Private |

Add subclause 12.3:

12.3 FLEXmux Descriptors

Directly derived from the FlexMux descriptor classes, hereafter are defined the FLEXMux descriptors pointed to by the “List of Class Tags for Descriptors” table.

12.3.1 FLEXmuxChannel Descriptor

12.3.1.1 Syntax

```
class FLEXmuxChannelDescriptor extends BaseDescriptor
    : bit(8) tag= FLEXmuxChannelDescrTag {
    bit(5) version_number;
    bit(1) current_next_indicator;
    const bit(2) reserved=0b11;
    for (i=0; i<( sizeOfInstance-2); i += 3) {
        bit(16) ES_ID;
        bit(8) FlexMuxChannel;
    }
}
```

12.3.1.2 Semantics

`version_number` -- This 5 bit field is the version number of the complete FLEXmuxChannelDescriptor. The version number shall be incremented by 1 whenever the definition of the FLEXmuxChannelDescriptor changes. Upon reaching the value 31, it wraps around to 0. When the `current_next_indicator` is set to '1', then the `version_number` shall be that of the currently applicable FLEXmuxChannelDescriptor. When the `current_next_indicator` is set to '0', then the `version_number` shall be that of the next applicable FLEXmuxChannelDescriptor.

`current_next_indicator` -- A 1 bit indicator, which when set to '1' indicates that the received FLEXmuxChannelDescriptor is currently applicable. When the bit is set to '0', it indicates that the received FLEXmuxChannelDescriptor is not yet applicable and shall be the next FLEXmuxChannelDescriptor to become valid.

A validity period of time is associated with each `version_number` of a FLEXmuxChannelDescriptor. It is only within that validity period of time, that FlexMux packets refer to the version identified by that `version_number`. The validity period of time of one version starts as soon as the first FLEXmuxChannelDescriptor is sent with the `current_next_indicator == 1`.

The validity period of time of one version ends as soon as an empty FLEXmuxChannelDescriptor is sent with the `current_next_indicator == 1`, meaning that the assignments of that version of the FLEXmuxChannelDescriptor are not any more relevant.

An empty FLEXmuxChannelDescriptor is a FLEXmuxChannelDescriptor shall be sent with `sizeOfInstance == 1`, such that there are no elementary streams described.

`ES_ID` – this 16-bit field specifies the identifier of an ISO/IEC 14496-1 SL-packetized stream.

`FlexMuxChannel` - This 8-bit field specifies the number of the FlexMux channel used for this SL-packetized stream.

12.3.2 FLEXmuxBufferSize Descriptor

12.3.2.1 Syntax

```
class FLEXmuxBufferSizeDescriptor extends BaseDescriptor
    : bit(8) tag= FLEXmuxBufferSizeDescrTag {
    DefaultFlexMuxBufferDescriptor()
    for (i=0; i<( sizeOfInstance-3); i += 4) {
        FlexMuxBufferDescriptor()
    }
}
```

12.3.2.2 Semantics

`DefaultFlexMuxBufferDescriptor` - The default size of multiplex buffers for each individual channel in a FlexMux stream is signalled by the `DefaultFlexMuxBufferDescriptor` class (see clause 11.2).

`FlexMuxBufferDescriptor`. The exact size of multiplex buffers for each channel in a FlexMux stream can be signalled by the `FlexMuxBufferDescriptor` class (see clause 11.2).

12.3.3 FLEXmuxTiming Descriptor

12.3.3.1 Syntax

```
class FLEXmuxTimingDescriptor extends BaseDescriptor
    : bit(8) tag= FLEXmuxTimingDescrTag {
    FlexMuxTimingDescriptor()
}
```

12.3.3.2 Semantics

FlexMuxTimingDescriptor – This descriptor class defines `FCR_ES_ID`, `FCRResolution`, `FCRLength`, `FmxRateLength`, see clause 11.2).

12.3.4 FLEXmuxCodeTable Descriptor

12.3.4.1 Syntax

```
class FLEXmuxCodeTableDescriptor extends BaseDescriptor
    : bit(8) tag= FLEXmuxCodeTableDescrTag {

        for(i =0; i < sizeOfInstance; i += sizeof ( MuxCodeTableEntry () ) )

    {

        MuxCodeTableEntry ()

    }

}
```

12.3.4.2 Semantics

MuxCodeTableEntry() – This class defines the FlexMux configuration of one FlexMux channel (see clause 11.2).

Several `FLEXmuxCodeTableDescriptor` may be used with different instances of the `MuxCodeTableEntry` class.

12.3.5 FLEXmuxIdent Descriptor

12.3.5.1 Syntax

```
class FLEXmuxIdentDescriptor extends BaseDescriptor
    : bit(8) tag= FLEXmuxIdentDescrTag {
    FlexMuxIDDescriptor ()
}
```

12.3.5.2 Semantics

FlexMuxIDDescriptor – This class defines `MuxID`, `Muxtype`, `Muxmanagement` (see clause 11.2).

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AMENDMENT 1: Extended BIFS

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee ISO/IEC JTC 1. 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 Amendment may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to International Standard ISO/IEC 14496-1:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

Information technology – Coding of audio-visual objects –

Part 1: Systems

AMENDMENT 1: Extended BIFS

1) Add the following at the end of subclause 8.6.15.3.1:

```
""
class QoS_Qualifier_REBUFFERING_RATIO extends QoS_Qualifier : bit(8) tag=0x02 {
    bit(8) REBUFFERING_RATIO;
}
"
```

2) Add the following at the end of subclause 8.6.15.3.2:

"
REBUFFERING_RATIO – Ratio of the decoding buffer that should be filled in case of prebuffering or rebuffering. The ratio is expressed in percentage, with an integer value between 0 and 100. Values outside that range are reserved.

8.6.15.3.2.1 Rebuffering

In certain scenarios the System Decoder Model cannot be strictly observed. This is the case of e.g. file retrieval scenarios in which the data is pulled from a remote server over a network with unpredictable performances. In such a case prebuffering and/or rebuffering may be required in order to allow for a better quality in the user experience. Note that scenarios involving real time streaming servers do not fall in this category, since a streaming server presumably delivers content according to the appropriate timeline.

An elementary stream is prebuffered when the decoder waits until the decodingBuffer has been filled up to a certain threshold before starting fetching data from it.

An elementary stream is rebuffed when a decoder stops fetching data from the decodingBuffer and before resuming fetching data waits until that buffer has been filled again up to a certain threshold.

In order to inform a receiver whether a certain elementary stream requires prebuffering and/or rebuffering the QoS_Qualifier_REBUFFERING_RATIO qualifier can be included in the Elementary Stream Descriptor (see subclause 8.6.15.3.1). By default, in the absence of such qualifier, an elementary stream does not require pre-buffering or rebuffering.

"

3) Replace Table 31 (Compensation process) in subclause 9.3.4 by the following:

"

Table 31 – Compensation process for multiple fields and BIFS-Anim

| quantType | animType | Compensation Process | | | | | | | | | | | | | | | | |
|--|--|--|---|--|---|--|---|--|----------------|---|--------------------|---|--|--|---|--|---|-------------------------|
| 1,2,4,6,7,8, 9 (other than SFVec3fType), 10 (other than SFRotationType), 11,12,13 | 1,2,4,6,7,8 11,12,13 | The components of v_q^2 are: $vq2[i] = vq1[i] + vDelta[i]$ | | | | | | | | | | | | | | | | |
| 9 (SFVec3fType), 10 (SFRotation) | 9,10 | <p>The addition is first performed component by component and stored in a temporary array: $vqTemp[i] = vq1[i] + vDelta[i]$.</p> <p>Let $scale = 2^{\max(0,nbBits-1)} - 1$.</p> <p>Let N the number of reduced components (2 for normals, 3 for rotations)</p> <p>There are then three cases are to be considered:</p> <table border="1"> <tr> <td>For every index i, $vqTemp[i] \leq scale$</td><td>v_q^2 is defined by, $vq2[i] = vqTemp[i]$ $orientation2 = orientation1$ $direction2 = direction1 * inverse$</td></tr> <tr> <td>There is one and only one index k such that $vqTemp[k] > scale$</td><td> v_q^2 is rescaled as if gliding on the faces of the mapping cube. <p>Let $inv = 1$ if $vqTemp[k] \geq 0$ and -1 else Let $dOri = k+1$</p> <p>The components of $vq2$ are computed as follows</p> <table border="1"> <tr> <td>$0 \leq i < N - dOri$</td><td>$vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$</td></tr> <tr> <td>$i = N - dOri$</td><td>$vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$</td></tr> <tr> <td>$N - dOri < i < N$</td><td>$vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$</td></tr> <tr> <td colspan="2">$orientation2 = (orientation1 + dOri) \bmod (N+1)$</td></tr> <tr> <td colspan="2">$direction2 = direction1 * inverse * inv$</td></tr> </table> </td></tr> <tr> <td>There are several indices k such that $vqTemp[k] > scale$</td><td>The result is undefined</td></tr> </table> | For every index i , $ vqTemp[i] \leq scale$ | v_q^2 is defined by, $vq2[i] = vqTemp[i]$ $orientation2 = orientation1$ $direction2 = direction1 * inverse$ | There is one and only one index k such that $ vqTemp[k] > scale$ | v_q^2 is rescaled as if gliding on the faces of the mapping cube. <p>Let $inv = 1$ if $vqTemp[k] \geq 0$ and -1 else Let $dOri = k+1$</p> <p>The components of $vq2$ are computed as follows</p> <table border="1"> <tr> <td>$0 \leq i < N - dOri$</td><td>$vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$</td></tr> <tr> <td>$i = N - dOri$</td><td>$vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$</td></tr> <tr> <td>$N - dOri < i < N$</td><td>$vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$</td></tr> <tr> <td colspan="2">$orientation2 = (orientation1 + dOri) \bmod (N+1)$</td></tr> <tr> <td colspan="2">$direction2 = direction1 * inverse * inv$</td></tr> </table> | $0 \leq i < N - dOri$ | $vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$ | $i = N - dOri$ | $vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$ | $N - dOri < i < N$ | $vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$ | $orientation2 = (orientation1 + dOri) \bmod (N+1)$ | | $direction2 = direction1 * inverse * inv$ | | There are several indices k such that $ vqTemp[k] > scale$ | The result is undefined |
| For every index i , $ vqTemp[i] \leq scale$ | v_q^2 is defined by, $vq2[i] = vqTemp[i]$ $orientation2 = orientation1$ $direction2 = direction1 * inverse$ | | | | | | | | | | | | | | | | | |
| There is one and only one index k such that $ vqTemp[k] > scale$ | v_q^2 is rescaled as if gliding on the faces of the mapping cube. <p>Let $inv = 1$ if $vqTemp[k] \geq 0$ and -1 else Let $dOri = k+1$</p> <p>The components of $vq2$ are computed as follows</p> <table border="1"> <tr> <td>$0 \leq i < N - dOri$</td><td>$vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$</td></tr> <tr> <td>$i = N - dOri$</td><td>$vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$</td></tr> <tr> <td>$N - dOri < i < N$</td><td>$vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$</td></tr> <tr> <td colspan="2">$orientation2 = (orientation1 + dOri) \bmod (N+1)$</td></tr> <tr> <td colspan="2">$direction2 = direction1 * inverse * inv$</td></tr> </table> | $0 \leq i < N - dOri$ | $vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$ | $i = N - dOri$ | $vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$ | $N - dOri < i < N$ | $vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$ | $orientation2 = (orientation1 + dOri) \bmod (N+1)$ | | $direction2 = direction1 * inverse * inv$ | | | | | | | | |
| $0 \leq i < N - dOri$ | $vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$ | | | | | | | | | | | | | | | | | |
| $i = N - dOri$ | $vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$ | | | | | | | | | | | | | | | | | |
| $N - dOri < i < N$ | $vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$ | | | | | | | | | | | | | | | | | |
| $orientation2 = (orientation1 + dOri) \bmod (N+1)$ | | | | | | | | | | | | | | | | | | |
| $direction2 = direction1 * inverse * inv$ | | | | | | | | | | | | | | | | | | |
| There are several indices k such that $ vqTemp[k] > scale$ | The result is undefined | | | | | | | | | | | | | | | | | |

Note: The BIFS-Anim process is identical to the process applied for optimal encoding of BIFS multiple fields.

"

4) Replace the reserved bit in subclause 9.3.5.3.1 by the following:

"

bit(1) usePredictiveMFField;

"

- 5) Insert the following in subclause 9.3.5.3.2 at the end of the second paragraph (on the `use3DmeshCoding`):

"
The `usePredictiveMFField` flag is used to signal that the syntax for predictive MFField instead of the non-predictive mode is used to encode IndexedFaceSet nodes. This flag is used for terminals supporting this tool.

"

- 6) Replace subclause 9.3.7.2.4 (**PROTOcode**) by the following subclauses:

"

9.3.7.2.4 PROTOcode

9.3.7.2.4.1 Syntax

```
class PROTOcode(isedNodeData protoData) {
    bit(1) isExtern
    if (isExtern) {
        MFUrl locations;
    } else {
        PROTOlist subProtos;
    }
    do {
        SFNode node(SFWorldNodeType,protoData);
        bit(1) moreNodes;
    } while (moreNodes);
    bit(1) hasROUTES;
    if (hasROUTES) {
        ROUTEs routes();
    }
}
```

9.3.7.2.4.2 Semantics

First a flag signals whether the prototype is a PROTO, which then has his code included in the proto declaration, or if is an EXTERNPROTO, in which case only an external reference is provided. The EXTERNPROTO is an authoring facility that enables to distribute PROTOs in external libraries and be reused across scenes. The EXTERNPROTO opens a BIFSCmd stream that contains a ReplaceScene command with a BIFSScene with the PROTO definitions. The EXTERNPROTO code is found in the PROTO in this new scene with the same ID in this scene. The nodes that may be contained in this scene are ignored.

In case of a PROTO, the PROTOcode contains a (possibly empty) list of the sub-PROTOs of this PROTO in subProtos, followed by the code to execute the PROTO. The code is specified as a set of SFNodes, using a standard SFNode definition with the additional possibility to declare an IS field. Moreover, the PROTO body may contain ROUTEs if the hasROUTE flag is set to 1.

"

7) Replace subclause 9.3.7.6 (**Field**) with the following subclauses:

9.3.7.6 Field

9.3.7.6.1 Syntax

```
class Field(FieldData field) {
    if (isSF(field))
        SFField svalue(field);
    else {
        if (BIFSConfig.usePredictiveMFField == 1) {
            bit(1) usePredictive;
            if (usePredictive)
                PredictiveMFField mvalue(field);
            else
                MFField mvalue(field);
        }
        else {
            MFField mvalue(field);
        }
    }
}
```

9.3.7.6.2 Semantics

A field is encoded according to its type: single (SFField) or multiple (MFField). A multiple field is a collection of single fields.

"

8) Add the following as new subclauses after subclause 9.3.7.9 (**MFVectorDescription**):

"

9.3.7.10 PredictiveMFField

9.3.7.10.1 Syntax

```
class PredictiveMFField (FieldData field) {
    AnimFieldQP aqp = new AnimFieldQP();
    aqp.useDefault = FALSE;
    field.aqp = aqp;
    ArrayHeader header(field);
    ArrayOfValues values(field);
}
```

9.3.7.10.2 Semantic

The array of data is composed of a **Header**, and an **ArrayOfValues**. Note that the FieldData structure is filled as described in the BIFS-Scene quantization process (subclause 9.3.3.1 of ISO/IEC 14496-1:2001).

The process applied for optimal encoding of BIFS multiple fields is exactly identical to the BIFS-Anim process (See Table 31):

- 1 Compensation on the P values
- 2 Inverse Quantization into single field values

The compensation process uses the quant type as well as Pmin and PNbBits, defined in the ArrayQP and InitialArrayQP, and can be summarized in the following table.

The inverse quantization process uses the values of floatMax, floatMin, and NbBit as defined in the BIFS quantization process and as defined by the QuantizationParameter node.

9.3.7.11 ArrayHeader

9.3.7.11.1 Syntax

```
class ArrayHeader(FieldData field){
    uint(5)      NbBits;
    int(NbBits)   numberOfFields;
    bit(2)       intraMode;
    InitialArrayQP qp(intraMode,field);
}
```

9.3.7.11.2 Semantic

The array header contains first information to specify the number of fields (**NbBits** is the number of bits used to code the **numberOfFields**). Then the Intra/Predictive policy (**intraMode**) is specified as follows:

- 0 : Only one Intra value at the beginning and then only predictive coded values
- 1 : An Intra every given number of predictive values
- 2 : A bit for each value to determine whether the value is an Intra or predictive value

Lastly, the **InitialArrayQP** is coded.

9.3.7.12 InitialArrayQP**9.3.7.12.1 Syntax**

```

class InitialArrayQP(int intraMode, FieldData field){
    switch (intraMode)
        case 1 :
            unsigned int(5)      NbBits;
            unsigned int(NbBits)  intraInterval;
            // no break
        case 0 :
        case 2 :
            int(5) CompNbBits;
            for (int i=0;i<getNbComp(field);i++) {
                int(field.NbBits+1) vq;
                field.aqp.Pmin[i] = vq-2^field.NbBits;
            }
        }
        // no break
    case 3:
        break;
}

```

9.3.7.12.2 Semantic

If intraMode is 1, the size of the interval between two intras is first specified. Independent of the intraMode, the number of Bits used in Predictive mode CompNbBits and the CompMins are coded. The function getNbComp() is a function that returns the number of components of the quantizing bounds, and depends on the object. For instance it returns 3 for 3D positions, 2 for 2D positions, and 3 for rotations. See Table 17 (Return values of getNbComp) in ISO/IEC 14496-1:2001. CompNbBits and CompMin are stored in the field.aqp AnimationQP structure, and are used for the compensation process as defined in Table 31 (Compensation process for multiple fields and BIFS-Anim) and subclause 9.3.4 of ISO/IEC 14496-1:2001.

9.3.7.13 ArrayQP

9.3.7.13.1 Syntax

```

class ArrayQP(int intraMode, FieldData field){
    switch (intraMode)
        case 1 :
            int NbBits;
            int(NbBits) intraInterval;
            // no break
        case 0 :
        case 2 :
            boolean(1) hasCompNbBits
            if (hasCompNbBits)
                int(5) CompNbBits;
            boolean(1) hasCompMin
            if (hasCompMin) {
                for (int i=0;i<NbComp(field)) {
                    int(field.NbBits+1) vq;
                    field.aqp.Pmin[i] = vq-2^field.NbBits;
                }
            }
            case 3:
                break;
}

```

9.3.7.13.2 Semantic

ArrayQP fulfills the same purpose as InitialArrayQP, but in this case, the parameters are optionnaly set. If they are not set in the stream, they are set by default, in reference to the InitialArrayQP or the latest received value of the parameter.

If IntraMode is 1, the size of the interval between two intras is first specified. In any case, the number of Bits used in Predictive mode (**CompNbBits**) and the **CompMins** are coded. The function `getNbComp()` is a function that returns the number of components of the quantizing bounds, and depends on the object. For instance it returns 3 for 3D positions, 2 for 2D positions, and 3 for rotations. See Table 17 in ISO/IEC 14496-1:2001. CompNbBits and CompMin are stored in the `field.aqp` AnimationQP structure, and are used for the compensation process as defined in Table 31 and subclause 9.3.4 of ISO/IEC 14496-1:2001.

9.3.7.14 ArrayOfValues**9.3.7.14.1 Syntax**

```

class ArrayOfValues(FieldData field) {
    ArrayIValue value[0];
    for (int i=1; i < numberOfFields;i++)
    {
        Switch (intraMode) {
            case 0:
                ArrayPValue value(field);
                break;
            case 1:
                if ( (i % intraInterval) == 0 ) {
                    bit(1) hasQP;
                    if (hasQP)
                        ArrayQP qp(field);
                    ArrayIValue value(field);
                } else {
                    ArrayPvalue value(field);
                }
                break;
            case 2:
                bit (1) isIntra;
                if (isIntra) {
                    bit(1) hasQP;
                    if (hasQP)
                        ArrayQP qp(field);
                    ArrayIValue value;
                } else {
                    ArrayPvalue value;
                }
                break;
        }
    }
}

```

9.3.7.14.2 Semantic

The array of values first codes a first intra value, and then according to the IntraMode, codes Intra and Predictive values. In P only mode, no more intra values are coded. In the second mode, a bit decides of the P or I mode at each value. In that case, a QP can be sent for Intra values. If a QP is sent, the statistics of the arithmetic encoder are reset. In the third mode, an Intra is sent every intraInterval values.

9.3.7.15 ArrayIValue

9.3.7.15.1 Syntax

```

class ArrayIValue(FieldData field) {
    switch (field.quantType) {
        case 9: // Normal
            int(1)      direction
        case 10: // Rotation
            int(2)      orientation
            break;
        default:
            break;
    }
    for (j=0;j<getNbComp(field);j++)
        int(field.nbBits) vq[j];
}

```

9.3.7.15.2 Semantic

The ArrayIValue represents the quantized intra value of a field. The value is coded following the quantization process described in the quantization section, and according to the type of the field. For normals the direction and orientation values specified in the quantization process are first coded. For rotations only the orientation value is coded. If the bit representing the direction is 0, the normal's direction is set to 1, if the bit is 1, the normal's direction is set to -1. The value of the orientation is coded as an unsigned integer using 2 bits. The compressed components vq[i] of the field's value are then coded as a sequence of unsigned integers using the number of bits specified in the field data structure. The decoding process in intra mode computes the animation values by applying the inverse quantization process.

9.3.7.16 ArrayPValue

9.3.7.16.1 Syntax

```
class ArrayPValue(FieldData field) {
    switch (field.quantType) {
        case 9: // Normal
            int(1) inverse
            break;
        default:
            break;
    }
    for (j=0;j<getNbComp(field);j++)
        int(aacNbBits) vqDelta[j];
}
```

9.3.7.16.2 Semantic

The ArrayPValue represents the difference between the previously received quantized value and the current quantized value of a field. The value is coded using the compensation process as described above. The values are decoded from the adaptive arithmetic coder bitstream with the procedure `v_aac = aa_decode(model)`. The model is updated with the procedure `model_update(model, v_aac)`. For normals the inverse value is decoded through the adaptive arithmetic coder with a uniform, non-updated model. The compensation values `vqDelta[i]` are then decoded one by one. Let `vq(t-1)` the quantized value decoded at the previous frame and `v_aac(t)` the value decoded by the frame's Adaptive Arithmetic Decoder at instant t with the field's models. The value a time t is obtained from the previous value as follows :

$$\begin{aligned}v\Delta(t) &= v_acc(t) + Pmin \\vq(t) &= AddDelta(vq(t-1), v\Delta(t)) \\v(t) &= InvQuant(vq(t))\end{aligned}$$

The field's models are updated each time a value is decoded through the adaptive arithmetic coder. If the animType is 1 (Position3D) or 2 (Position2D), each component of the field's value is using its own model and offset `PMin[i]`. In all other cases the same model and offset `PMin[0]` is used for all the components.

"

9) *Modify the subclause numbers in 9.3.7.10 to 9.3.8.10 after the insertion of **ArrayPValue** subclause.*

10) *Insert the following as a new subclause after subclause 9.4.2.92 (Script):*

"

9.4.2.93 ServerCommand

The ServerCommand in BIFS enables the application signaling in MPEG-4 Systems. The application-signaling framework allows an application to communicate the application signaling messages or commands to a server(s). Commands are sent to servers upon the occurrence of events (synchronous events specified in the scene description or asynchronous events as a result of user interaction). The ServerCommand framework consists of two elements; a ServerCommand node, and a

ServerCommandRequest structure. While the ServerCommand enables event routing to the server, the ServerCommandRequest structure specifies the syntax for the messages communicated to the server over a back channel.

9.4.2.93.1 Node Interface

ServerCommand {

| | | | |
|--------------|----------|----------------|-------|
| eventIn | SFBool | trigger | |
| exposedField | SFBool | enable | FALSE |
| exposedField | MFString | url | [] |
| exposedField | SFString | command | "" |
| } | | | |

9.4.2.93.2 Functionality and Semantics

This node is used to communicate application-signaling messages (commands) from the client back to the server. The ServerCommand is processed only when **trigger** receives a TRUE event and **enable** is TRUE. When the ServerCommand is processed, the **command** is sent to the servers indicated by the specified **url**. A **url** identifies the object descriptor that contains an elementary stream that flows from the terminal back to the server. If that object descriptor has more than one such elementary stream, then the one specified will be used. The **command** field contains the information that is transmitted back to the server. The syntax and semantics of the **command** string are application specific and not specified. The syntax of the **ServerCommandRequest** structures used to communicate the **command** to a server is specified below.

9.4.2.93.3 ServerCommandRequest

When the ServerCommand is processed the associated **command** is communicated to the servers specified in the **url** using the **ServerCommandRequest** structures. The ServerCommandRequest is encapsulated into SL packets, using the SLConfigDescriptor contained in the ESDescriptor of the upchannel elementary stream that carries the commands. If a timestamp is provided in the SL layer (either decoding or composition) then it is directly derived from the System Time Base of the terminal.

Syntax

```
class ServerCommandRequest(BIFSConfig cfg) {
    bit(cfg.nodeIDbits) nodeID;
    SFString command;
}
```

where **nodeID** is node ID of the ServerCommand node that trigger the command (all such nodes must have IDs in order to route events into them), and **command** is the string contained in the ServerCommand node's **command** field.

- 11) *Modify the subclause numbers in 9.4.2.93 to 9.4.2.99 after the insertion of **ServerCommand** node subclause.*
- 12) *Insert the following as a new subclause after subclause 9.4.2.99 (**Switch**):*
"

9.4.2.100 TemporalGroup

The **TemporalGroup** node carries the temporal constraints of its child nodes that will be used by the FlexTime model (or Advanced Synchronization Model). The FlexTime Model supports synchronization of objects from multiple sources with possibly different time bases. The FlexTime Model specifies timing using a flexible, constraint-based timing model. In this model, media objects can be linked to one another in a time graph using relationship constraints such as "CoStart", "CoEnd", or "Meet". And, in addition, to allow some flexibility to meet these constraints, each object may have a flexible duration with specific stretch and shrink mode preferences that may be applied.

The FlexTime model is based upon a so-called "spring" metaphor. A spring has a set of three constants: the minimum length below which it will not shrink, the maximum length beyond which it will break, and the optimal length at which it rests comfortably being neither compressed nor extended. Following this spring model, the temporal playback of media objects can be viewed as springs, with a set of playback durations corresponding to these three spring constants. The optimal playback duration (optimal spring length) can be viewed as the author's preferred choice of playback duration for the media object. A player should, where possible, keep the playback length as close to the optimal duration as the presentation allows but may choose any duration between the minimum and maximum durations as specified by the author. Note, that whereas stretching or shrinking the duration continuous media, e.g. for video, implies respectively slowing down or speeding up playback, for discrete media such as a still image, shrinking or stretching is merely adjusting the rendering period to be shorter or longer.

The FlexTime model requires a small change to the MPEG-4 buffer model in terms of media delivery and decoding. Decoding may be delayed on the client, beyond the standard decoding time, by an amount determined by the flexibility expressed in the relationships. The buffer model for FlexTime can thus be specified as follows: "At any time from the instant of time corresponding to its DTS up to a time limit specified by FlexTime, and AU is instantaneously decoded and removed from the decoding buffer."

To support synchronization of nodes within the scene to a media stream, or part thereof, a new node supporting flexible transformation to scene time is introduced. This grouping node is the **TemporalTransform** and can flexibly support the slowing down, speeding up, freezing or shifting of the scene time for rendering of nodes contained within. This transform node is also a grouping node and provides the flexible component for the FlexTime model.

The **TemporalGroup** provides the constraint for the FlexTime model and gives it the tools it needs to align in time both nodes and media streams with nodes in the scene graph. **TemporalGroup** can examine the temporal properties of its children, check for the availability of media in the composition buffer, and consequently decide which temporal transformation parameters to apply to each of its child nodes.

9.4.2.100.1 Node Interface

TemporalGroup {

| | | |
|--------------|---------|-----------------------|
| eventIn | MFNode | addChildren |
| eventIn | MFNode | removeChildren |
| exposedField | MFNode | children |
| field | SFBool | costart |
| field | SFBool | coend |
| field | SFBool | meet |
| exposedField | MFFloat | priority |
| eventOut | SFBool | isActive |
| eventOut | SFInt32 | activeChild |

}

9.4.2.100.2 Functionality and semantics

The **TemporalGroup** node specifies the temporal relationship between a given number of **TemporalTransform** nodes.

The **children** field specifies the list of **TemporalTransform** or **TemporalGroup** nodes on which the constraint is applied.

The **costart**, **coend** and **meet** fields specify the temporal relationships amongst the node's **children**. If **costart** is TRUE, all child nodes must be activated (start) together. If **coend** is TRUE, all child nodes must be deactivated (end) together. When **meet** is TRUE, the child nodes are activated one after another in a row. When one node ends, the next node in the list needs to start. If either **costart** or **coend** are set to TRUE the **meet** field is ignored.

The **priority** field specifies the list of priority numbers that determines the preferred scaling direction when two child nodes need to meet a constraint. The list of priorities is in the same order as the **children** field. More than one child can have the same value. In the case of **coend** the highest priority object will determine the end and cause all other objects to end at that time, providing all objects have at least reached their minimum durations. If the field is empty all nodes are assumed to have equal priority.

The **isActive** eventOut is triggered at the following events.

- If **costart** is true a TRUE value will be sent when the co-start constraint is met.
- If **coend** is true a FALSE value will be sent when the co-end constraint is met.
- If **meet** is true a TRUE value will be sent when the first child is activated, and a FALSE value will be sent when the last one finishes.

The **activeChild** eventOut is sent when a new child is activated under a **meet** constant and will indicate the index of that child. The first child is index 0.

9.4.2.101 TemporalTransform

TemporalTransform is a grouping node that assigns temporal properties, and applies temporal transformation, to scene nodes and elementary streams.

9.4.2.101.1 Node Interface

TemporalTransform {

| | | | |
|--------------|----------|------------------------|------------|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | |
| exposedField | MFString | url | [] |
| exposedField | SFTime | startTime | -1.0 |
| exposedField | SFTime | optimalDuration | -1.0 |
| exposedField | SFBool | active | FALSE |
| exposedField | SFFloat | speed | 1.0 |
| exposedField | SFVec2F | scalability | [1.0, 1.0] |
| exposedField | MFInt32 | stretchMode | [0] |
| exposedField | MFInt32 | shrinkMode | [0] |
| exposedField | SFTime | maxDelay | 0 |
| eventOut | SFTime | actualDuration | |

}

9.4.2.101.2 Functionality and semantics

The **TemporalTransform** node serves two purposes:

- o To apply temporal transformation to media objects.
- o To hold properties that will be used when the node has as a parent a **TemporalGroup** node.

The node operates on two types of objects. Its **children** field may contain a list of nodes of the type SF3DNode. In addition, it has a **url** field that may reference an elementary stream. In the first case, the node has the effect of slowing down, speeding up, freezing or shifting the time base of the compositor when it renders the child nodes that are transformed by the node. In the second case, the node affects the time base of the stream. Note that a Route between two nodes whose time bases are different, because one or both are affected by a **TemporalTransform**, will have undefined behavior.

The **startTime** specifies the starting point of the media stream relative to the composition time of the first access unit received from the **url** that is controlled by this node. If **startTime** is negative, the entire media referred by this **url** is controlled.

The **optimalDuration** field specifies the nominal duration of the objects that are controlled by this node. This is also the *optimal* duration, which the FlexTime model opts for when scaling this node. If **optimalDuration** is negative, or outside the bounds defined by the **scalability** field, optimal duration is not available.

The **active** field determines whether the node, its children, and the stream controlled by the node are active. When the node is inactive, the time base of the compositor is frozen when the child nodes are composed. This means that:

- The nodes are not visible and the stream is not played.
- Timed nodes, e.g. **TimeSensor**, do not have their time running.
- Node fields such as **startTime** and **stopTime** are processed as if the time is not running.
- Nodes that react to user interaction, such as **TouchSensor**, or to their spatial position, such as **ProximitySensors** cannot be activated.

However operations that would normally be performed at that time are still performed, even if the node is frozen. For instance:

- **Script** nodes are executed if activated.
- **ROUTEs** are executed.
- **eventIns** are processed (with no rendering).
- DMIF (network stack) methods are called if necessary. Therefore the delivery of streams, if required, will be requested, even though their sync layer time base is frozen.

Another field that affects the temporal transformation is **speed**. When the value of this field is not 1 and the node is active, the scene time base of the node, its children, and the time base of the stream will slow down or speed up according to this factor. If **speed** is set to zero, the node remains active but its time stops. Therefore time-related operations behave as if time is constant, and audio rendering pauses.

The other fields of the **TemporalTransform** node have no effect on the execution of the node, but are used by a parent **TemporalGroup** node to determine the temporal layout of the node in relation to other **TemporalTransform** objects.

The **scalability** field specifies the maximum ratios by which this object is allowed to shrink or stretch. If a nominal duration is known, either from **optimalDuration** or the stream length, the ratio determines the absolute values of the minimum and maximum duration. Otherwise, for unknown duration, the field dictates either the ratio by which the time bases controlled by the node are allowed to scale; or, when **optimalDuration** lies outside the bound of the values calculated, they are minimum and maximum durations (optimal duration unknown).

The **stretchMode** field specifies an ordered list of the preferred modes of stretching according to the table below.

The **shrinkMode** field specifies an ordered list of the preferred modes of shrinking according to the table below.

Table 39 — Preferred Mode of Stretch/Shrink Values

| StretchMode Value | StretchMode Description |
|-------------------|---|
| 0 | Hold rendering of the last Access Unit |
| 1 | Linear Composition Unit rendering rate decrease |
| 2 | Repeat |

| ShrinkMode Value | ShrinkMode Description |
|------------------|---|
| 0 | Stop rendering |
| 1 | Linear Composition Unit rendering rate increase |

The **maxDelay** field specifies how long the FlexTime model can wait for the stream specified by the **url** field. If this time elapses before the stream is available, the model behaves as if the node starts at that time, but the player will not render the children of this node and will discard the stream if it arrives later.

The **actualDuration** eventOut is triggered when the node is activated and sends the value of the estimated actual play duration of the node.

"

- 13) *Modify the table numbers 39 to 60 after the insertion of **TemporalTransform** node subclause.*
- 14) *Modify the subclause numbers 9.4.2.100 to 9.4.2.111 after the insertion of **TemporalTransform** node subclause.*
- 15) *Insert the following item as the last bullet item in subclause 15.3.2 (Scene Graph Profiles Tools):*
"• 3D audio scene graph profile as defined in 15.3.3.3.
"

- 16) *Add the following subclause as a new subclause at the end of subclause 15.3.3.2:*
"

15.3.3.3 3D Audio Scene Graph Profile

The 3D Audio Scene Graph profile provides tools for three-dimensional sound positioning in relation either with acoustic parameters of the scene or its perceptual attributes. The user can interact with the scene by changing the position of the sound source, changing the room effect or by moving the listening point.

The following list defines the 3D Audio Profile scene graph profiles:

AcousticScene, Anchor, AudioBuffer, AudioClip, AudioDelay, AudioFX, AudioMix, AudioSource, AudioSwitch, Billboard, Conditional, DirectiveSound, Group, Inline, ListeningPoint, LOD, NavigationInfo, OrderedGroup, PerceptualParameters, QuantizationParameter, Sound, Sound2D, Switch, Transform, Viewpoint, WorldInfo, Node Update, Route Update, Scene Update, AnimationStream, Script, CoordinateInterpolator, OrientationInterpolator, PositionInterpolator, PositionInterpolator2D, ProximitySensor, ROUTE, TermCap, TimeSensor, TouchSensor, VisibilitySensor, Valuator.
"

- 17) *Replace subclause 15.3.4.1.2 (Levels) by the following subclause:*
"

15.3.4.1.2 3D Audio Profile Level Definitions

In the following table, levels definitions for the 3D Audio profile are given. The levels are based on sampling rate of 44100 Hz at 16-bit resolution. Their complexities depend on

- The maximum number of spatialized sources per scene (these spatialized sources can include discrete reflections that are perceptually equivalent to individual sound sources)
- The number of temporal sections whose levels and time limits can be controlled individually for each source
- The maximum number of independent late reverberation processes per scene
- The maximum number of control frequencies in reverberation process filters, source directivity filters, and material filters.

Table 62 – 3D Audio Scene Graph Profile Levels

| Level | Level 1 | Level 2 | Level 3 | Level 4 |
|---|----------------|----------------|----------------|----------------|
| Maximum number of spatialized sources per scene | 8 | 32 | 64 | 128 |
| Number of temporal sections whose levels and time limits can be controlled individually for each source | 1 | 1 | 2 | 3 |
| Maximum number of independent late reverberation processes per scene | 1 | 1 | 2 | 4 |
| Maximum number of control frequencies in reverberation process filters, source directivity filters, and material filters | 2 | 2 | 3 | 3 |

" 18) *Modify the table numbers 62 to 66 after the insertion of 15.3.4.1.2 (3D Audio Profile Level Definitions).*

" 19) *Insert the following item at the end of subclause 15.4.2 :*

- 3D Audio Graphics Profile as defined in subclause 15.4.3.1.

" 20) *Add the following subclause as a new subclause at the end of subclause 15.4.3 (Graphics Profiles) :*

15.4.3.1 3D Audio Graphics Profile

This profile defines graphics tools that are required to define the acoustical properties of the scene (geometry, acoustics absorption, diffusion, transparency of the material). The following list defines the 3D Audio Graphics profile: AcousticMaterial, Appearance, Coordinate, IndexedFaceSet, Normal, Shape.

" 21) *Add the following subclause as a new subclause after subclause 15.4.4.3 (Levels for the Complete Graphics Profile):*

15.4.4.4 3D Audio Graphics Level Definitions

No visual rendering should be implemented.

22) After H.4.9 (*SFWorldNode*), add the following as a new clause:

"

H.5 Node Tables for Extended Nodes (V3)

H.5.1 ServerCommand

| | | |
|----------------------|---|----------------|
| ServerCommand | SFWorldNode SF2DNode SF3DNode | 11 11 11 |
| Field name | Field type | DEF id |
| trigger | SFBool | 00 |
| enable | SFBool | 00 |
| url | MFUrl | 01 |
| command | SFString | 10 |
| | | 11 |
| | | 10 |

H.5.2 TemporalGroup

| | | |
|----------------------|---|----------------------|
| TemporalGroup | SFWorldNode SFTemporalNode SF2Dnode SF3Dnode | 10 11 10 10 |
| Field name | Field type | DEF id |
| addChildren | MFTemporalNode | 00 |
| removeChildren | MFTemporalNode | 01 |
| children | MFTemporalNode | 000 |
| costart | SFBool | 001 |
| coend | SFBool | 010 |
| meet | SFBool | 011 |
| priority | MFFloat | 100 |
| isActive | SFBool | 11 |
| activeChild | SFInt32 | 10 |

H.5.3 TemporalTransform

| | | |
|--------------------------|---|----------------------|
| TemporalTransform | SFWorldNode SFTemporalNode SF2Dnode SF3Dnode | 01 10 01 01 |
| Field name | Field type | DEF id |
| addChildren | MF3DNode | 0000 |
| removeChildren | MF3DNode | 0001 |
| children | MF3DNode | 0000 |
| url | MFURL | 0001 |
| startTime | SFTime | 0010 |
| optimalDuration | SFTime | 0011 |
| active | SFBool | 0100 |
| speed | MFFloat | 0101 |
| scalability | SFVec2F | 0110 |
| stretchMode | MFInt32 | 0111 |
| shrinkMode | MFInt32 | 1000 |
| maxDelay | SFTime | 1001 |
| actualDuration | SFTime | 1011 |
| | | 1010 |

H.6 Node Definition Type Tables (V3)

Legend:

| Node Definition Type | | Number of nodes | | | |
|----------------------|----------|-----------------|----|-----|-----|
| Node name | nodeType | DEF | IN | OUT | DYN |

H.6.1 SF2DNode

| SF2Dnode | | 2 Nodes | | | |
|-----------------------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| TemporalTransform | 01 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |
| TemporalGroup | 10 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ServerCommand | 11 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.6.2 SF3DNode

| SF3Dnode | | 2 Nodes | | | |
|-----------------------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| TemporalTransform | 01 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |
| TemporalGroup | 10 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ServerCommand | 11 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.6.3 SFTemporalNode

| SFTemporalNode | | 2 Nodes | | | |
|-----------------------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| TemporalTransform | 01 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |
| TemporalGroup | 10 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.6.4 SFWorldNode

| SFWorldNode | | 2 Nodes | | | |
|-----------------------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| TemporalTransform | 01 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |
| TemporalGroup | 10 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ServerCommand | 11 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

"

23) Add the following as a new Annex after Annex V.

"

Annex W (informative)

FlexTime behavior

W.1 FlexTime behavior

At a very basic level, FlexTime allows nodes and a media stream to be synchronized, such that the nodes and the texture (coming from a media stream) can be rendered together. To do this, we transform the

scene for the nodes to co-start with the media stream. We achieve this effect by inserting the nodes under a **TemporalTransform**. The removal of a node can also be synchronized with the end of the stream in this manner.

When the FlexTime manager has no corrections to make, the playback speed of continuous media is set to meet the optimal duration and hence this speed is expected to be the normal standard playback speed. The timing relationships of the temporal groups allow flexibility of duration. Alteration of duration can be done through adjustment of playing speed to allow these timing relationships to be met. Without playback speed modification only truncate and freeze are possible. Alterations, when permitted, are specified in the **TemporalTransform** with stretch and shrink preferences. Playback speed is not expressed explicitly in the **TemporalTransform** at all - rather the speed can be adjusted to meet timing needs and as such playback speed is a secondary effect not the prime motivator behind FlexTime. The prime motivator being synchronization and timing adjustments using application-level (author) specified guidelines.

W.2 Updates of fields

In order to support synchronization of field value replacements with a temporally transformed scene, an appropriate construct other than directly replacing the field with a BIFS command may need to be chosen. Such a construct should be temporally transformed commensurate with the scene that it is to update. For example a time sensor/valuator/route combination can be used, or a BIFS command frame containing the replace field can be put into a conditional node that is activated at the desired (temporally transformed) time.

BIFS-Anim streams, being media streams, can be re-timed as is done for other media streams.

W.3 Authoring considerations

W.3.1 Plan the possible different playback scenarios

Authors should take special care so that the MPEG-4 usual constraints are always respected. However, authors should avoid possible ODid overlapping and Nodeid overlapping as streams are flexed for instance. Furthermore, it is possible to reuse ODid, but the author should ensure that streams that designate 2 different ODs, using the same ODid, should not occur together anywhere under a **TemporalGroup**.

W.3.2 Flexed Objects

The objects that are affected by the FlexTime model, called “flexed” objects, may be streams, such as a movie or audio clips, part of streams, or graphic animations, such as a progress bar, a revolving globe, an opening door etc. Such animations can be realized in MPEG via animation streams and BIFS update, but also by through interaction between scene nodes, Routes and **TimeSensor** nodes.

W.3.3 Why a *children* field?

The case when a “flexed” object is a stream is well covered with the **url** field in **TemporalTransform**. However, we need to support “flexed” objects that are made of group of scene nodes and interaction between them. For instance consider the case of two movies that are played one after the other, with a “credits” screen shown in between. The credits screen shows a scroll of textual information that needs to start after the first movie ends and complete when the next movie starts. However, the end and start times of the two movies are not fully deterministic and might shift in time. In this case we have three “flexed” objects – the two movies and the credit screen in between. The *FlexTime* model enables the

player to apply temporal transformation on the objects so that they do play in perfect sequence. Therefore the speed of the text scrolling in the credit screen may be changed by the model.

With the current proposal, this scenario would be implemented very easily. The two movies will be defined in the **url** fields of two **TemporalTransform** nodes, while the entire set of scene nodes that consist the credit screen would be referenced by the *children* field of a third **TemporalTransform** node. The **TemporalGroup** node would then define a *meet* constraint on these three objects.

It might be claimed that the same effect can be achieved without a *children* field, by defining only the two movies as “flexed” objects, and use the events generated when the two objects start and stop, routed into **Conditional** nodes, interpolators, evaluators and scripts. In theory this may work, but would be extremely difficult to author and there is no proof it will work in all cases.

"

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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 part of ISO/IEC 14496 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 14496-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 14496-1:1999), which has been technically revised.

ISO/IEC 14496 consists of the following parts, under the general title *Information technology — Coding of audio-visual objects*:

- *Part 1: Systems*
- *Part 2: Visual*
- *Part 3: Audio*
- *Part 4: Conformance testing*
- *Part 5: Reference software*
- *Part 6: Delivery Multimedia Integration Framework (DMIF)*
- *Part 7: Optimized software for MPEG-4 visual tools*

Annexes C, G, H, U and V form a normative part of this part of ISO/IEC 14496. Annexes A, B, D, E, F and I to T are for information only.

0 Introduction

0.1 Overview

ISO/IEC 14496 specifies a system for the communication of interactive audio-visual scenes. This specification includes the following elements:

1. the coded representation of natural or synthetic, two-dimensional (2D) or three-dimensional (3D) objects that can be manifested audibly and/or visually (audio-visual objects) (specified in part 1,2 and 3 of ISO/IEC 14496);
2. the coded representation of the spatio-temporal positioning of audio-visual objects as well as their behavior in response to interaction (scene description, specified in this part of ISO/IEC 14496);
3. the coded representation of information related to the management of data streams (synchronization, identification, description and association of stream content, specified in this part of ISO/IEC 14496); and
4. a generic interface to the data stream delivery layer functionality (specified in part 6 of ISO/IEC 14496).
5. an application engine for programmatic control of the player: format, delivery of downloadable Java byte code as well as its execution lifecycle and behavior through APIs (specified in this part of ISO/IEC 14496); and
6. a file format to contain the media information of an ISO/IEC 14496 presentation in a flexible, extensible format to facilitate interchange, management, editing, and presentation of the media.

The overall operation of a system communicating audio-visual scenes can be paraphrased as follows:

At the sending terminal, the audio-visual scene information is compressed, supplemented with synchronization information and passed to a delivery layer that multiplexes it into one or more coded binary streams that are transmitted or stored. At the receiving terminal, these streams are demultiplexed and decompressed. The audio-visual objects are composed according to the scene description and synchronization information and presented to the end user. The end user may have the option to interact with this presentation. Interaction information can be processed locally or transmitted back to the sending terminal. ISO/IEC 14496 defines the syntax and semantics of the bitstreams that convey such scene information, as well as the details of their decoding processes.

This part of ISO/IEC 14496 specifies the following tools:

- a terminal model for time and buffer management;
- a coded representation of interactive audio-visual scene description information (Binary Format for Scenes – BIFS);
- a coded representation of metadata for the identification, description and logical dependencies of the elementary streams (object descriptors and other descriptors);
- a coded representation of descriptive audio-visual content information (object content information – OCI);
- an interface to intellectual property management and protection (IPMP) systems;
- a coded representation of synchronization information (sync layer – SL); and
- a multiplexed representation of individual elementary streams in a single stream (FlexMux).
- an application engine (MPEG-Java - MPEG-J).

These various elements are described functionally in this subclause and specified in the normative clauses that follow.

0.2 Architecture

The information representation specified in ISO/IEC 14496-1 describes the means to create an interactive audio-visual scene in terms of coded audio-visual information and associated scene description information. The entity

that composes and sends, or receives and presents such a coded representation of an interactive audio-visual scene is generically referred to as an "audio-visual terminal" or just "terminal". This terminal may correspond to a standalone application or be part of an application system.

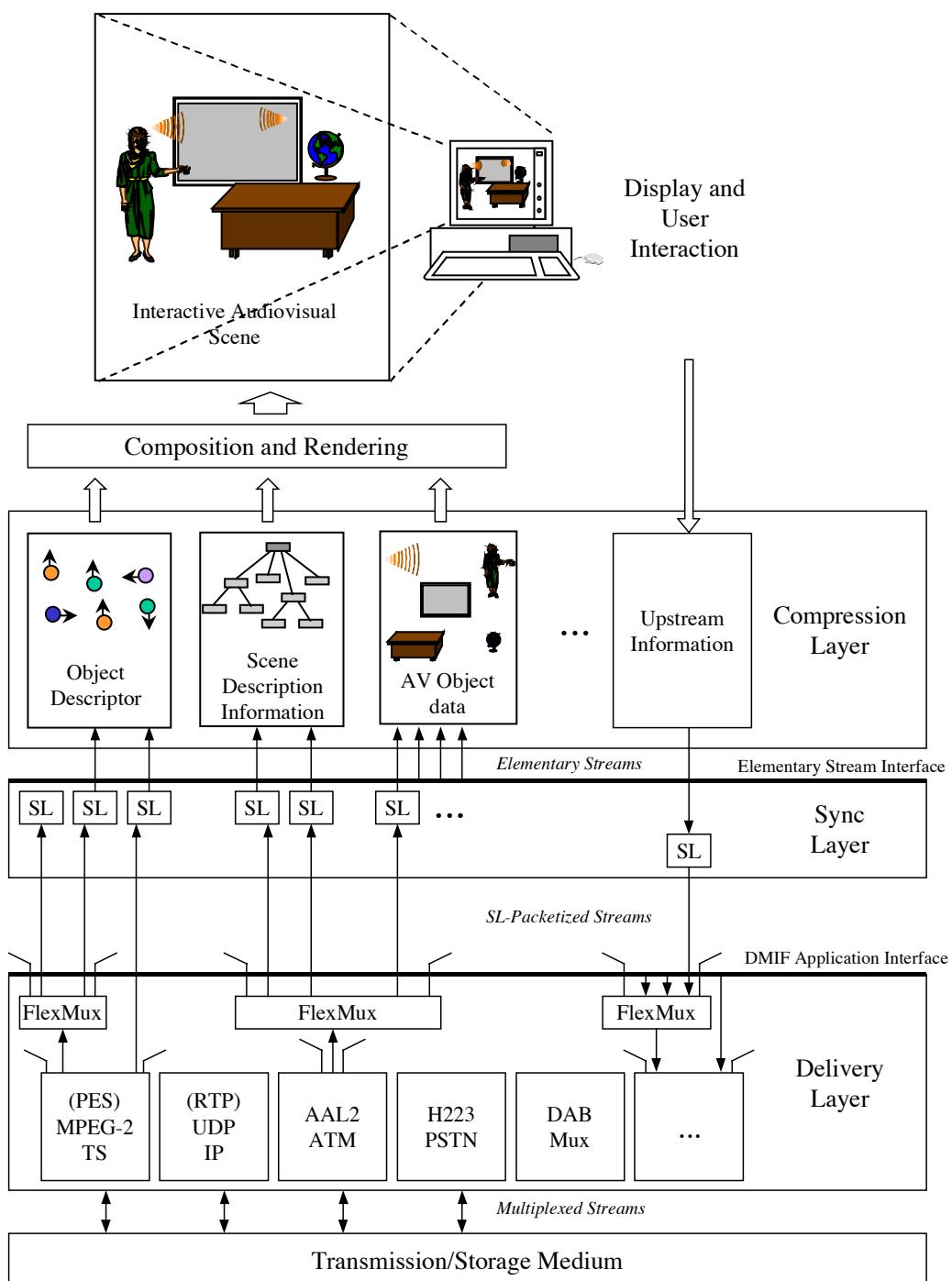


Figure 1 - The ISO/IEC 14496 terminal architecture

The basic operations performed by such a receiver terminal are as follows. Information that allows access to content complying with ISO/IEC 14496 is provided as initial session set up information to the terminal. Part 6 of ISO/IEC 14496 defines the procedures for establishing such session contexts as well as the interface to the delivery layer that generically abstracts the storage or transport medium. The initial set up information allows, in a recursive manner, to locate one or more elementary streams that are part of the coded content representation. Some of these elementary streams may be grouped together using the multiplexing tool described in ISO/IEC 14496-1.

Elementary streams contain the coded representation of either audio or visual data or scene description information. Elementary streams may as well themselves convey information to identify streams, to describe logical dependencies between streams, or to describe information related to the content of the streams. Each elementary stream contains only one type of data.

Elementary streams are decoded using their respective stream-specific decoders. The audio-visual objects are composed according to the scene description information and presented by the terminal's presentation device(s). All these processes are synchronized according to the systems decoder model (SDM) using the synchronization information provided at the synchronization layer.

These basic operations are depicted in Figure 1, and are described in more detail below.

0.3 Terminal Model: Systems Decoder Model

The systems decoder model provides an abstract view of the behavior of a terminal complying with ISO/IEC 14496-1. Its purpose is to enable a sending terminal to predict how the receiving terminal will behave in terms of buffer management and synchronization when reconstructing the audio-visual information that comprises the presentation. The systems decoder model includes a systems timing model and a systems buffer model which are described briefly in the following subclauses.

0.3.1 Timing Model

The timing model defines the mechanisms through which a receiving terminal establishes a notion of time that enables it to process time-dependent events. This model also allows the receiving terminal to establish mechanisms to maintain synchronization both across and within particular audio-visual objects as well as with user interaction events. In order to facilitate these functions at the receiving terminal, the timing model requires that the transmitted data streams contain implicit or explicit timing information. Two sets of timing information are defined in ISO/IEC 14496-1: clock references and time stamps. The former convey the sending terminal's time base to the receiving terminal, while the latter convey a notion of relative time for specific events such as the desired decoding or composition time for portions of the encoded audio-visual information.

0.3.2 Buffer Model

The buffer model enables the sending terminal to monitor and control the buffer resources that are needed to decode each elementary stream in a presentation. The required buffer resources are conveyed to the receiving terminal by means of descriptors at the beginning of the presentation. The terminal can then decide whether or not it is capable of handling this particular presentation. The buffer model allows the sending terminal to specify when information may be removed from these buffers and enables it to schedule data transmission so that the appropriate buffers at the receiving terminal do not overflow or underflow.

0.4 Multiplexing of Streams: The Delivery Layer

The term delivery layer is used as a generic abstraction of any existing transport protocol stack that may be used to transmit and/or store content complying with ISO/IEC 14496. The functionality of this layer is not within the scope of ISO/IEC 14496-1, and only the interface to this layer is considered. This interface is the DMIF Application Interface (DAI) specified in ISO/IEC 14496-6. The DAI defines not only an interface for the delivery of streaming data, but also for signaling information required for session and channel set up as well as tear down. A wide variety of delivery mechanisms exist below this interface, with some of them indicated in Figure 1. These mechanisms serve for transmission as well as storage of streaming data, i.e., a file is considered to be a particular instance of a delivery layer. For applications where the desired transport facility does not fully address the needs of a service according to the specifications in ISO/IEC 14496, a simple multiplexing tool (FlexMux) with low delay and low overhead is defined in ISO/IEC 14496-1.

0.5 Synchronization of Streams: The Sync Layer

Elementary streams are the basic abstraction for any streaming data source. Elementary streams are conveyed as sync layer-packetized (SL-packetized) streams at the DMIF Application Interface. This packetized representation additionally provides timing and synchronization information, as well as fragmentation and random access information. The sync layer (SL) extracts this timing information to enable synchronized decoding and, subsequently, composition of the elementary stream data.

0.6 The Compression Layer

The compression layer receives data in its encoded format and performs the necessary operations to decode this data. The decoded information is then used by the terminal's composition, rendering and presentation subsystems.

0.6.1 Object Description Framework

The purpose of the object description framework is to identify and describe elementary streams and to associate them appropriately to an audio-visual scene description. Object descriptors serve to gain access to ISO/IEC 14496 content. Object content information and the interface to intellectual property management and protection systems are also part of this framework.

An object descriptor is a collection of one or more elementary stream descriptors that provide the configuration and other information for the streams that relate to either an audio-visual object or a scene description. Object descriptors are themselves conveyed in elementary streams. Each object descriptor is assigned an identifier (object descriptor ID), which is unique within a defined name scope. This identifier is used to associate audio-visual objects in the scene description with a particular object descriptor, and thus the elementary streams related to that particular object.

Elementary stream descriptors include information about the source of the stream data, in form of a unique numeric identifier (the elementary stream ID) or a URL pointing to a remote source for the stream. Elementary stream descriptors also include information about the encoding format, configuration information for the decoding process and the sync layer packetization, as well as quality of service requirements for the transmission of the stream and intellectual property identification. Dependencies between streams can also be signaled within the elementary stream descriptors. This functionality may be used, for example, in scalable audio or visual object representations to indicate the logical dependency of a stream containing enhancement information, to a stream containing the base information. It can also be used to describe alternative representations for the same content (e.g. the same speech content in various languages).

0.6.1.1 Intellectual Property Management and Protection

The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems. The IPMP interface consists of IPMP elementary streams and IPMP descriptors. IPMP descriptors are carried as part of an object descriptor stream. IPMP elementary streams carry time variant IPMP information that can be associated to multiple object descriptors.

The IPMP System itself is a non-normative component that provides intellectual property management and protection functions for the terminal. The IPMP System uses the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. An application may choose not to use an IPMP System, thereby offering no management and protection features.

0.6.1.2 Object Content Information

Object content information (OCI) descriptors convey descriptive information about audio-visual objects. The main content descriptors are: content classification descriptors, keyword descriptors, rating descriptors, language descriptors, textual descriptors, and descriptors about the creation of the content. OCI descriptors can be included directly in the related object descriptor or elementary stream descriptor or, if it is time variant, it may be carried in an elementary stream by itself. An OCI stream is organized in a sequence of small, synchronized entities called events that contain a set of OCI descriptors. OCI streams can be associated to multiple object descriptors.

0.6.2 Scene Description Streams

Scene description addresses the organization of audio-visual objects in a scene, in terms of both spatial and temporal attributes. This information allows the composition and rendering of individual audio-visual objects after the respective decoders have reconstructed the streaming data for them. For visual data, ISO/IEC 14496-1 does not mandate particular composition algorithms. Hence, visual composition is implementation dependent. For audio data, the composition process is defined in a normative manner in 9.2.2.13 and ISO/IEC 14496-3.

The scene description is represented using a parametric approach (BIFS - Binary Format for Scenes). The description consists of an encoded hierarchy (tree) of nodes with attributes and other information (including event sources and targets). Leaf nodes in this tree correspond to elementary audio-visual data, whereas intermediate nodes group this material to form audio-visual objects, and perform grouping, transformation, and other such

operations on audio-visual objects (scene description nodes). The scene description can evolve over time by using scene description updates.

In order to facilitate active user involvement with the presented audio-visual information, ISO/IEC 14496-1 provides support for user and object interactions. Interactivity mechanisms are integrated with the scene description information, in the form of linked event sources and targets (routes) as well as sensors (special nodes that can trigger events based on specific conditions). These event sources and targets are part of scene description nodes, and thus allow close coupling of dynamic and interactive behavior with the specific scene at hand. ISO/IEC 14496-1, however, does not specify a particular user interface or a mechanism that maps user actions (e.g., keyboard key presses or mouse movements) to such events.

Such an interactive environment may not need an upstream channel, but ISO/IEC 14496 also provides means for client-server interactive sessions with the ability to set up upstream elementary streams and associate them to specific downstream elementary streams.

0.6.3 Audio-visual Streams

The coded representations of audio and visual information are described in ISO/IEC 14496-3 and ISO/IEC 14496-2, respectively. The reconstructed audio-visual data are made available to the composition process for potential use during the scene rendering.

0.6.4 Upchannel Streams

Downchannel elementary streams may require upchannel information to be transmitted from the receiving terminal to the sending terminal (e.g., to allow for client-server interactivity). Figure 1 indicates the flowpath for an elementary stream from the receiving terminal to the sending terminal. The content of upchannel streams is specified in the same part of the specification that defines the content of the downstream data. For example, upchannel control streams for video downchannel elementary streams are defined in ISO/IEC 14496-2.

0.7 Application Engine

The MPEG-J is a programmatic system (as opposed to a conventional parametric system) which specifies API for interoperation of MPEG-4 media players with Java code. By combining MPEG-4 media and safe executable code, content creators may embed complex control and data processing mechanisms with their media data to intelligently manage the operation of the audio-visual session. The parametric MPEG-4 System forms the Presentation Engine while the MPEG-J subsystem controlling the Presentation Engine forms the Application Engine.

The Java application is delivered as a separate elementary stream to the MPEG-4 terminal. There it will be directed to the MPEG-J run time environment, from where the MPEG-J program will have access to the various components and required data of the MPEG-4 player to control it.

In addition to the basic packages of the language (java.lang, java.io, java.util) a few categories of APIs have been defined for different scopes. For Scene graph API the objective is to provide access to the scene graph: to inspect the graph, to alter nodes and their fields, and to add and remove nodes within the graph. The Resource API is used for regulation of performance: it provides a centralized facility for managing resources. This is used when the program execution is contingent upon the terminal configuration and its capabilities, both static (that do not change during execution) and dynamic. Decoder API allows the control of the decoders that are present in the terminal. The Net API provides a way to interact with the network, being compliant to the MPEG-4 DMIF Application Interface. Complex applications and enhanced interactivity are possible with these basic packages. The architecture of MPEG-J will be presented in more detail in clause 11.

Information technology – Coding of audio-visual objects –

Part 1: Systems

1 Scope

This part of ISO/IEC 14496 specifies system level functionalities for the communication of interactive audio-visual scenes. More specifically:

1. system level description of the coded representation of natural or synthetic, two-dimensional (2D) or three-dimensional (3D) objects that can be manifested audibly and/or visually (audio-visual objects);
2. the coded representation of the spatio-temporal positioning of audio-visual objects as well as their behavior in response to interaction (scene description); and
3. the coded representation of information related to the management of data streams (synchronization, identification, description and association of stream content).
4. a system level description of an application engine (format, delivery, lifecycle, and behavior of downloadable Java byte code applications); and
5. a system level interchange and storage format of interactive audio-visual scenes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14496. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 14496 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

ISO 9613-1:1993, *Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of the absorption of sound by the atmosphere*

ISO/IEC 10646-1:2000, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane*

ISO/IEC 11172-2:1993, *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 2: Video*

ISO/IEC 11172-3:1993, *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 3: Audio*

ISO/IEC 13818-3:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 14496-1:2001(E)

ISO/IEC 13818-7:1997, *Information technology — Generic coding of moving pictures and associated audio information — Part 7: Advanced Audio Coding (AAC)*

ISO/IEC 14496-2:1999, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14772-1:1998, *Information technology — Computer graphics and image processing — The Virtual Reality Modeling Language — Part 1: Functional specification and UTF-8 encoding*

ISO/IEC 14772-1:1998/Amd.1, *Information technology — Computer graphics and image processing — The Virtual Reality Modeling Language — Part 1: Functional specification and UTF-8 encoding, Amendment 1: Enhanced interoperability*

ISO/IEC 16262:¹⁾, *Information technology — ECMAScript language specification*

ITU-T Rec. H.262 (2000) | ISO/IEC 13818-2:2000, *Information technology — Generic coding of moving pictures and associated audio information: Video*

ITU-T Rec. T.81 (1992) | ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

IEEE Std 754-1985, *Standard for Binary Floating-Point Arithmetic*

Addison-Wesley:September 1996, *The Java Language Specification*, by James Gosling, Bill Joy and Guy Steele, ISBN 0-201-63451-1

Addison-Wesley:September 1996, *The Java Virtual Machine Specification*, by T. Lindholm and F. Yellin, ISBN 0-201-63452-X

Addison-Wesley:July 1998, *Java Class Libraries Vol. 1 The Java Class Libraries*, Second Edition Volume 1, by Patrick Chan, Rosanna Lee and Douglas Kramer, ISBN 0-201-31002-3

Addison-Wesley:July 1998, *Java Class Libraries Vol. 2 The Java Class Libraries*, Second Edition Volume 2, by Patrick Chan and Rosanna Lee, ISBN 0-201-31003-1

Addison-Wesley, May 1996, *Java API, The Java Application Programming Interface, Volume1: Core Packages*, by J. Gosling, F. Yellin and the Java Team, ISBN 0-201-63453-8

DAVIC 1.4.1 specification Part 9: Information Representation

ANSI/SMPTE 291M-1996, *Television — Ancillary Data Packet and Space Formatting*

SMPTE 315M -1999, *Television — Camera Positioning Information Conveyed by Ancillary Data Packets*

3 Additional reference

ISO/IEC 13522-6:1998, *Information technology — Coding of multimedia and hypermedia information — Part 6: Support for enhanced interactive applications*. This reference contains the full normative references to Java APIs and the Java Virtual Machine as described in the normative references above.

4 Terms and definitions

For the purposes of this part of ISO/IEC 14496, the following terms and definitions apply.

¹⁾ To be published. (Revision of ISO/IEC 16262:1998)

4.1 Access Unit (AU)

An individually accessible portion of data within an *elementary stream*. An access unit is the smallest data entity to which timing information can be attributed.

4.2 Alpha Map

The representation of the transparency parameters associated with a texture map.

4.3 Atom

An object-oriented building block defined by a unique type identifier and length.

4.4 Audio-visual Object

A representation of a natural or synthetic object that has an audio and/or visual manifestation. The representation corresponds to a node or a group of nodes in the BIFS scene description. Each audio-visual object is associated with zero or more *elementary streams* using one or more *object descriptors*.

4.5 Audio-visual Scene (AV Scene)

A set of audio-visual objects together with scene description information that defines their spatial and temporal attributes including behaviors resulting from object and user interactions.

4.6 Binary Format for Scene (BIFS)

A coded representation of a parametric scene description format.

4.7 Buffer Model

A model that defines how a terminal complying with ISO/IEC 14496 manages the buffer resources that are needed to decode a presentation.

4.8 Byte Aligned

A position in a coded bit stream with a distance of a multiple of 8-bits from the first bit in the stream.

4.9 Chunk

A contiguous set of samples stored for one stream.

4.10 Clock Reference

A special time stamp that conveys a reading of a time base.

4.11 Composition

The process of applying scene description information in order to identify the spatio-temporal attributes and hierarchies of audio-visual objects..

4.12 Composition Memory (CM)

A random access memory that contains composition units.

4.13 Composition Time Stamp (CTS)

An indication of the nominal composition time of a composition unit.

4.14 Composition Unit (CU)

An individually accessible portion of the output that a decoder produces from access units.

4.15 Compression Layer

The layer of a system according to the specifications in ISO/IEC 14496 that translates between the coded representation of an elementary stream and its decoded representation. It incorporates the decoders.

4.16 Container Atom

An atom whose sole purpose is to contain and group a set of related atoms.

4.17 Decoder

An entity that translates between the coded representation of an elementary stream and its decoded representation.

4.18 Decoding buffer (DB)

A buffer at the input of a decoder that contains access units.

4.19 Decoder configuration

The configuration of a decoder for processing its elementary stream data by using information contained in its elementary stream descriptor.

4.20 Decoding Time Stamp (DTS)

An indication of the nominal decoding time of an access unit.

4.21 Delivery Layer

A generic abstraction for delivery mechanisms (computer networks, etc.) able to store or transmit a number of multiplexed elementary streams or FlexMux streams.

4.22 Descriptor

A data structure that is used to describe particular aspects of an elementary stream or a coded audio-visual object.

4.23 DMIF Application Interface (DAI)

An interface specified in ISO/IEC 14496-6. It is used here to model the exchange of SL-packetized stream data and associated control information between the sync layer and the delivery layer.

4.24 Elementary Stream (ES)

A consecutive flow of mono-media data from a single source entity to a single destination entity on the compression layer.

4.25 Elementary Stream Descriptor

A structure contained in object descriptors that describes the encoding format, initialization information, sync layer configuration, and other descriptive information about the content carried in an elementary stream.

4.26 Elementary Stream Interface (ESI)

A conceptual interface modeling the exchange of elementary stream data and associated control information between the compression layer and the sync layer.

4.27 FlexMux Channel (FMC)

A label to differentiate between data belonging to different constituent streams within one FlexMux Stream. A sequence of data in one FlexMux channel within a FlexMux stream corresponds to one single SL-packetized stream.

4.28 FlexMux Packet

The smallest data entity managed by the FlexMux tool. It consists of a header and a payload.

4.29 FlexMux Stream

A sequence of FlexMux Packets with data from one or more SL-packetized streams that are each identified by their own FlexMux channel.

4.30 FlexMux tool

A tool that allows the interleaving of data from multiple data streams.

4.31 Graphics Profile

A profile that specifies the permissible set of graphical elements of the BIFS tool that may be used in a scene description stream. Note that BIFS comprises both graphical and scene description elements.

4.32 Hint Track

A special track which contains instructions for packaging one or more tracks into a TransMux. It does not contain media data (an elementary stream).

4.33 Hinter

A tool that is run on a completed file to add one or more hint tracks to the file to facilitate streaming.

4.34 Inter

A mode for coding parameters that uses previously coded parameters to construct a prediction.

4.35 Intra

A mode for coding parameters that does not make reference to previously coded parameters to perform the encoding.

4.36 Initial Object Descriptor

A special object descriptor that allows the receiving terminal to gain initial access to portions of content encoded according to ISO/IEC 14496. It conveys profile and level information to describe the complexity of the content.

4.37 Intellectual Property Identification (IPI)

A unique identification of one or more elementary streams corresponding to parts of one or more audio-visual objects.

4.38 Intellectual Property Management and Protection (IPMP) System

A generic term for mechanisms and tools to manage and protect intellectual property. Only the interface to such systems is normatively defined.

4.39 Movie Atom

A container atom whose sub-atoms define the meta-data for a presentation ('moov').

4.40 Movie Data Atom

A container atom which can hold the actual media data for a presentation ('mdat').

4.41 MP4 File

The name of the file format described in this specification.

4.42 Object Clock Reference (OCR)

A clock reference that is used by a decoder to recover the time base of the encoder of an elementary stream.

4.43 Object Content Information (OCI)

Additional information about content conveyed through one or more elementary streams. It is either aggregated to individual elementary stream descriptors or is itself conveyed as an elementary stream.

4.44 Object Descriptor (OD)

A descriptor that aggregates one or more elementary streams by means of their elementary stream descriptors and defines their logical dependencies.

4.45 Object Descriptor Command

A command that identifies the action to be taken on a list of object descriptors or object descriptor IDs, e.g., update or remove.

4.46 Object Descriptor Profile

A profile that specifies the configurations of the object descriptor tool and the sync layer tool that are allowed.

4.47 Object Descriptor Stream

An elementary stream that conveys object descriptors encapsulated in object descriptor commands.

4.48 Object Time Base (OTB)

A time base valid for a given elementary stream, and hence for its decoder. The OTB is conveyed to the decoder via object clock references. All time stamps relating to this object's decoding process refer to this time base.

4.49 Parametric Audio Decoder

A set of tools for representing and decoding speech signals coded at bit rates between 6 Kbps and 16 Kbps, according to the specifications in ISO/IEC 14496-3.

4.50 Quality of Service (QoS)

The performance that an elementary stream requests from the delivery channel through which it is transported. QoS is characterized by a set of parameters (e.g., bit rate, delay jitter, bit error rate, etc.).

4.51 Random Access

The process of beginning to read and decode a coded representation at an arbitrary point within the elementary stream.

4.52 Reference Point

A location in the data or control flow of a system that has some defined characteristics.

4.53 Rendering

The action of transforming a scene description and its constituent audio-visual objects from a common representation space to a specific presentation device (i.e., speakers and a viewing window).

4.54 Rendering Area

The portion of the display device's screen into which the scene description and its constituent audio-visual objects are to be rendered.

4.55 Sample

An access unit for an elementary stream. In hint tracks, a sample defines the formation of one or more TransMux packets.

4.56 Sample Table

A packed directory for the timing and physical layout of the samples in a track.

4.57 Scene Description

Information that describes the spatio-temporal positioning of audio-visual objects as well as their behavior resulting from object and user interactions. The scene description makes reference to elementary streams with audio-visual data by means of pointers to object descriptors.

4.58 Scene Description Stream

An elementary stream that conveys scene description information.

4.59 Scene Graph Elements

The elements of the BIFS tool that relate only to the structure of the audio-visual scene (spatio-temporal positioning of audio-visual objects as well as their behavior resulting from object and user interactions) excluding the audio, visual and graphics nodes as specified in clause 15.

4.60 Scene Graph Profile

A profile that defines the permissible set of scene graph elements of the BIFS tool that may be used in a scene description stream. Note that BIFS comprises both graphical and scene description elements.

4.61 SL-Packetized Stream (SPS)

A sequence of sync layer packets that encapsulate one elementary stream.

4.62 Structured Audio

A method of describing synthetic sound effects and music as defined by ISO/IEC 14496-3.

4.63 Sync Layer (SL)

A layer to adapt elementary stream data for communication across the DMIF Application Interface, providing timing and synchronization information, as well as fragmentation and random access information. The sync layer syntax is configurable and can be configured to be empty.

4.64 Sync Layer Configuration

A configuration of the sync layer syntax for a particular elementary stream using information contained in its elementary stream descriptor.

4.65 Sync Layer Packet (SL-Packet)

The smallest data entity managed by the sync layer consisting of a configurable header and a payload. The payload may consist of one complete access unit or a partial access unit.

4.66 Syntactic Description Language (SDL)

A language defined by ISO/IEC 14496-1 that allows the description of a bitstream's syntax.

4.67 Systems Decoder Model (SDM)

A model that provides an abstract view of the behavior of a terminal compliant to ISO/IEC 14496. It consists of the buffer model and the timing model.

4.68 System Time Base (STB)

The time base of the terminal. Its resolution is implementation-dependent. All operations in the terminal are performed according to this time base.

4.69 Terminal

A system that sends, or receives and presents the coded representation of an interactive audio-visual scene as defined by ISO/IEC 14496-1. It can be a standalone system, or part of an application system complying with ISO/IEC 14496.

4.70 Time Base

The notion of a clock; it is equivalent to a counter that is periodically incremented.

4.71 Timing Model

A model that specifies the semantic meaning of timing information, how it is incorporated (explicitly or implicitly) in the coded representation of information, and how it can be recovered at the receiving terminal.

4.72 Time Stamp

An indication of a particular time instant relative to a time base.

4.73 Track

A collection of related samples in an MP4 file. For media data, a track corresponds to an elementary stream. For hint tracks, a track corresponds to a TransMuxchannel

5 Abbreviations and Symbols

| | |
|------|--|
| AU | Access Unit |
| AV | Audio-visual |
| BIFS | Binary Format for Scene |
| CM | Composition Memory |
| CTS | Composition Time Stamp |
| CU | Composition Unit |
| DAI | DMIF Application Interface (see ISO/IEC 14496-6) |
| DB | Decoding Buffer |
| DTS | Decoding Time Stamp |
| ES | Elementary Stream |
| ESI | Elementary Stream Interface |
| ESID | Elementary Stream Identifier |
| FAP | Facial Animation Parameters |
| FAPU | FAP Units |
| FDP | Facial Definition Parameters |
| FIG | FAP Interpolation Graph |
| FIT | FAP Interpolation Table |
| FMC | FlexMux Channel |
| FMOD | The floating point modulo (remainder) operator which returns the remainder of x/y such that: Fmod(x/y) = x - k*y, where k is an integer, sgn(fmod(x/y)) = sgn(x), and abs(fmod(x/y)) < abs(y) |
| IP | Intellectual Property |
| IPI | Intellectual Property Identification |
| IPMP | Intellectual Property Management and Protection |
| NCT | Node Coding Tables |
| NDT | Node Data Type |
| NINT | Nearest INTeger value |
| OCI | Object Content Information |
| OCR | Object Clock Reference |
| OD | Object Descriptor |
| ODID | Object Descriptor Identifier |
| OTB | Object Time Base |
| PLL | Phase Locked Loop |
| QoS | Quality of Service |
| SAOL | Structured Audio Orchestra Language |
| SASL | Structured Audio Score Language |
| SDL | Syntactic Description Language |
| SDM | Systems Decoder Model |
| SL | Synchronization Layer |

| | |
|-----------|-----------------------------------|
| SL-Packet | Synchronization Layer Packet |
| SPS | SL-Packetized Stream |
| STB | System Time Base |
| TTS | Text-To-Speech |
| URL | Universal Resource Locator |
| VOP | Video Object Plane |
| VRML | Virtual Reality Modeling Language |

6 Conventions

For the purpose of unambiguously defining the syntax of the various bitstream components defined by the normative parts of ISO/IEC 14496 a *syntactic description language* is used. This language allows the specification of the mapping of the various parameters in a binary format as well as how they are placed in a serialized bitstream. The definition of the language is provided in clause 14.

7 Systems Decoder Model

7.1 Introduction

The purpose of the systems decoder model (SDM) is to provide an abstract view of the behavior of a terminal complying with ISO/IEC 14496. It may be used by the sender to predict how the receiving terminal will behave in terms of buffer management and synchronization when decoding data received in the form of elementary streams. The systems decoder model includes a timing model and a buffer model.

The systems decoder model specifies:

1. the interface for accessing demultiplexed data streams (DMIF Application Interface),
 2. decoding buffers for coded data for each elementary stream,
 3. the behavior of elementary stream decoders,
 4. composition memory for decoded data from each decoder, and
 5. the output behavior of composition memory towards the compositor.

These elements are depicted in Figure 2. Each elementary stream is attached to one single decoding buffer. More than one elementary stream may be connected to a single decoder (e.g., in a decoder of a scaleable audio-visual object).

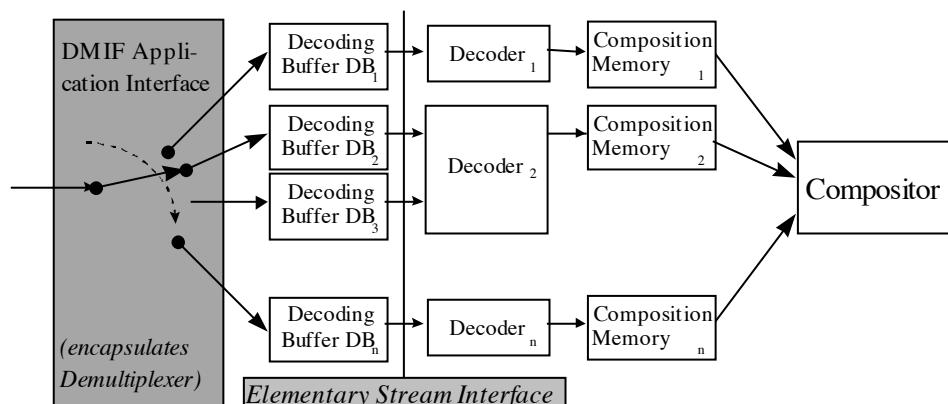


Figure 2 - Systems Decoder Model

7.2 Concepts of the systems decoder model

This subclause defines the concepts necessary for the specification of the timing and buffering model. The sequence of definitions corresponds to a walk from the left to the right side of the SDM illustration in Figure 2.

7.2.1 DMIF Application Interface (DAI)

For the purposes of the systems decoder model, the DMIF Application Interface encapsulates the demultiplexer and provides access to streaming data that is consumed by the decoding buffers. The streaming data received through the DAI consists of SL-packetized streams. The required properties of the DAI are described in 10.3. The DAI semantics are fully specified in ISO/IEC 14496-6.

7.2.2 SL-Packetized Stream (SPS)

An SL-packetized stream consists of a sequence of packets, according to the syntax and semantics specified in 10.2, that encapsulate a single elementary stream. The packets contain elementary stream data partitioned in access units as well as side information, e.g., for timing and access unit labeling. SPS data payload enters the decoding buffers, i.e., the side information is removed at the input to the decoding buffers.

7.2.3 Access Units (AU)

Elementary stream data is partitioned into access units. The delineation of an access unit is completely determined by the entity that generates the elementary stream (e.g., the compression layer). An access unit is the smallest data entity to which timing information can be attributed. Two access units from the same elementary stream shall never refer to the same decoding or composition time. Any further partitioning of the data in an elementary stream is not visible for the purposes of the systems decoder model. Access units are conveyed by SL-packetized streams and are received by the decoding buffers. The decoders consume access units with the necessary side information (e.g., time stamps) from the decoding buffers.

NOTE — An ISO/IEC 14496-1 compliant terminal implementation is not required to process each incoming access unit as a whole. It is furthermore possible to split an access unit into several fragments for transmission as specified in clause 10. This allows the sending terminal to dispatch partial AUs immediately as they are generated during the encoding process. Such partial AUs may have significance for improved error resilience.

7.2.4 Decoding Buffer (DB)

The decoding buffer is a buffer at the input of an elementary stream decoder in the receiving terminal that receives and stores access units. The systems buffer model enables the sending terminal to monitor the decoding buffer resources that are used during a presentation.

7.2.5 Elementary Streams (ES)

Streaming data received at the output of a decoding buffer, independent of its content, is considered as an elementary stream for the purpose of ISO/IEC 14496. The elementary streams are produced and consumed by the compression layer entities (encoders and decoders, respectively). ISO/IEC 14496 assumes that the integrity of an elementary stream is preserved from end to end.

7.2.6 Elementary Stream Interface (ESI)

The elementary stream interface is a concept that models the exchange of elementary stream data and associated control information between the compression layer and the sync layer. It is explained further in Annex L.

7.2.7 Decoder

For the purposes of this model, the decoder extracts access units from the decoding buffer at precisely defined points in time and places composition units, the results of the decoding processes, in the composition memory. A decoder may be attached to several decoding buffers.

7.2.8 Composition Units (CU)

Decoders consume access units and produce composition units. An access unit corresponds to an integer number of composition units. Composition units reside in composition memory.

7.2.9 Composition Memory (CM)

The composition memory is a random access memory that contains composition units. The size of this memory is not normatively specified.

7.2.10 Compositor

The compositor takes composition units out of the composition memory and either consumes them (e.g. composes and presents them, in the case of audio-visual data) or skips them. The compositor is not specified in ISO/IEC 14496-1, as the details of this operation are not relevant within the context of the systems decoder model. Subclause 7.3.5 defines which composition units are available to the compositor at any instant of time.

7.3 Timing Model Specification

The timing model relies on clock references and time stamps to synchronize audio-visual data conveyed by one or more elementary streams. The concept of a clock with its associated clock references is used to convey the notion of time to a receiving terminal. Time stamps are used to indicate the precise time instants at which the receiving terminal consumes the access units in the decoding buffers or may access the composition units resident in the composition memory. The time stamps are therefore associated with access units and composition units. The semantics of the timing model are defined in the subsequent clauses. The syntax for conveying timing information is specified in 10.2.

NOTE — This timing model is designed for rate-controlled (“push”) applications.

7.3.1 System Time Base (STB)

The system time base (STB) defines the terminal’s notion of time. The resolution of the STB is implementation dependent. All actions of the terminal are scheduled according to this time base for the purpose of this timing model.

NOTE — This does not imply that all terminals compliant with ISO/IEC 14496 operate on one single STB.

7.3.2 Object Time Base (OTB)

The object time base (OTB) defines the notion of time for a given data stream. The resolution of this OTB can be selected as required by the application or as defined by a profile. All time stamps that the sending terminal inserts in a coded data stream refer to this time base. The OTB of a data stream is known at the receiving terminal either by means of object clock reference information inserted in the stream or by an indication that its time base is slaved to a time base conveyed with another stream, as specified in 10.2.3.

NOTE 1 — Elementary streams may be created for the sole purpose of conveying time base information.

NOTE 2 — The receiving terminal’s system time base need not be locked to any of the available object time bases.

7.3.3 Object Clock Reference (OCR)

A special kind of time stamps, object clock references (OCR), are used to convey the OTB to the elementary stream decoder. The value of the OCR corresponds to the value of the OTB at the time the sending terminal generates the object clock reference time stamp. OCR time stamps are placed in the SL packet header as described in 10.2.4. The receiving terminal shall evaluate the OCR when its last bit is extracted at the input of the decoding buffer.

7.3.4 Decoding Time Stamp (DTS)

Each access unit has an associated nominal decoding time, the time at which it must be available in the decoding buffer for decoding. The AU is not guaranteed to be available in the decoding buffer either before or after this time. Decoding is assumed to occur instantaneously when the instant of time indicated by the DTS is reached.

This point in time can be implicitly specified if the (constant) temporal distance between successive access units is indicated in the setup of the elementary stream (see 10.2.3). Otherwise a decoding time stamp (DTS) whose syntax is defined in 10.2.4 conveys this point in time.

A decoding time stamp shall only be conveyed for an access unit that carries a composition time stamp as well, and only if the DTS and CTS values are different. Presence of both time stamps in an AU may indicate a reversal between coding order and composition order.

7.3.5 Composition Time Stamp (CTS)

Each composition unit has an associated nominal composition time, the time at which it must be available in the composition memory for composition. The CU is not guaranteed to be available in the composition memory *for composition* before this time. Since the SDM assumes an instantaneous decoding process, the CU is available to the *decoder*, at that instant in time corresponding to the DTS of the corresponding AU, for further use (e.g. in prediction processes).

This instant in time is implicitly known, if the (constant) temporal distance between successive composition units is indicated in the setup of the elementary stream. Otherwise a composition time stamp (CTS) whose syntax is defined in 10.2.4 conveys this instant in time.

The current CU is instantaneously accessible by the compositor anytime between its composition time and the composition time of the subsequent CU. If a subsequent CU does not exist, the current CU becomes unavailable at the end of the lifetime of its elementary stream (i.e., when its elementary stream descriptor is removed).

7.3.6 Occurrence and Precision of Timing Information in Elementary Streams

The frequency at which DTS, CTS and OCR values are to be inserted in the bitstream as well as the precision, jitter and drift are application and profile dependent. Some usage considerations can be found in 10.2.7.

7.3.7 Time Stamps for Dependent Elementary Streams

An audio-visual object may refer to multiple elementary streams that constitute a scaleable content representation (see 8.7.1.5). Such a set of elementary streams shall adhere to a single object time base. Temporally co-located access units for such elementary streams are then identified by identical DTS or CTS values.

EXAMPLE

The example in Figure 3 illustrates the arrival of two access units at the Systems Decoder. Due to the constant delay assumption of the model (see 7.4.2 below), the arrival times correspond to the instants in time when the sending terminal has sent the respective AUs. The sending terminal must select this instant in time so that the Decoding Buffer at the receiving terminal never overflows or underflows. At the receiving terminal, an AU is instantaneously decoded, at that instant in time corresponding to its DTS, and the resulting CU(s) are placed in the composition memory and remain there until the subsequent CU(s) arrive or the associated object descriptor is removed.

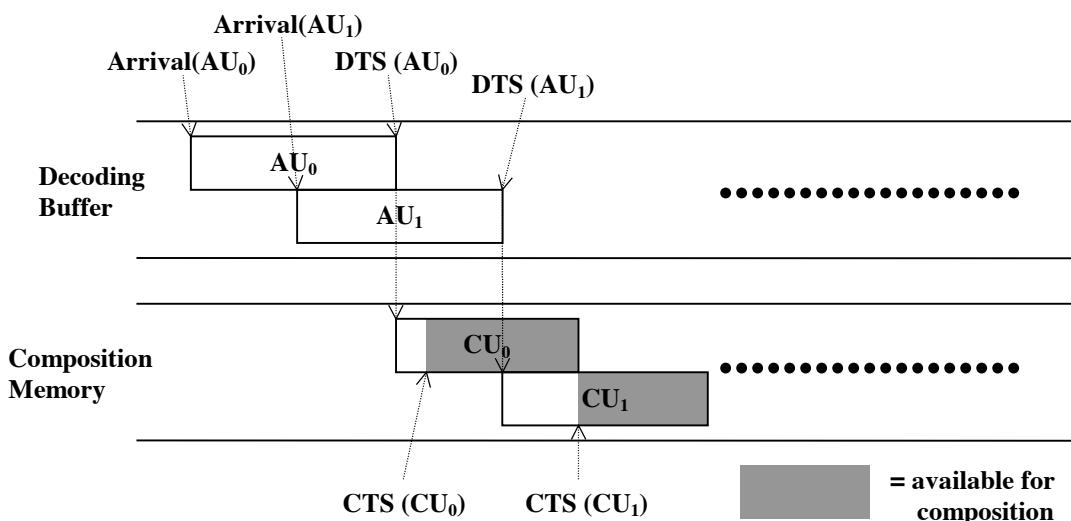


Figure 3 - Composition unit availability

7.4 Buffer Model Specification

7.4.1 Elementary Decoder Model

Figure 4 indicates one branch of the systems decoder model (Figure 2). This simplified model is used to specify the buffer model. It treats each elementary stream separately and therefore, associates a composition memory with only one decoder. The legend following Figure 4 elaborates on the symbols used in this figure.

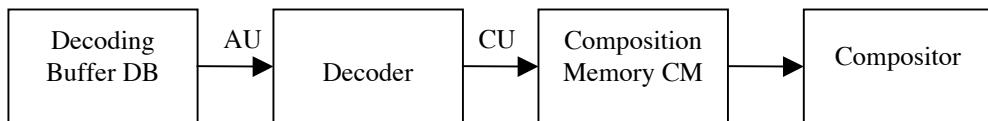


Figure 4 - Flow diagram for the systems decoder model

Legend:

| | |
|----|--|
| DB | Decoding buffer for the elementary stream. |
| CM | Composition memory for the elementary stream. |
| AU | The current access unit input to the decoder. |
| CU | The current composition unit input to the composition memory. CU results from decoding AU. There may be several composition units resulting from decoding one access unit. |

7.4.2 Assumptions

7.4.2.1 Constant end-to-end delay

Data transmitted in real time have a timing model in which the end-to-end delay from the encoder input at the sending terminal, to the decoder output at the receiving terminal, is constant. This delay is equal to the sum of the delay due to the encoding process, subsequent buffering, multiplexing at the sending terminal, the delay due to the delivery layers and the delay due to the demultiplexing, decoder buffering and decoding processes at the receiving terminal.

Note that the receiving terminal is free to add a temporal offset (delay) to the absolute values of all time stamps if it can cope with the additional buffering needed. However, the temporal difference between two time stamps (that determines the temporal distance between the associated AUs or CUs) has to be preserved for real-time performance.

NOTE — Two elementary streams that adhere to different time bases may be synchronized tightly in case of constant end-to-end delay as assumed by this model. If an application cannot implement this model assumption, such tight synchronization may not be achievable. Tolerances for the constant end-to-end delay assumption need to be defined through the profile and level mechanism.

7.4.2.2 Demultiplexer

The end-to-end delay between multiplexer output, at the sending terminal, and demultiplexer input, at the receiving terminal, is constant.

7.4.2.3 Decoding Buffer

The needed decoding buffer size is known by the sending terminal and conveyed to the receiving terminal as specified in 8.6.6.

The size of the decoding buffer is measured in bytes.

The decoding buffer is filled at the rate given by the maximum bit rate for this elementary stream while data is available and with a zero rate otherwise. The maximum bit rate is conveyed by the sending terminal as a part of the decoder configuration information during the set up phase for each elementary stream (see 8.6.6).

Information is received from the DAI in the form of SL packets. The SL packet headers are removed at the input to the decoding buffers.

7.4.2.4 Decoder

The decoding processes are assumed to be instantaneous for the purposes of the systems decoder model.

7.4.2.5 Composition Memory

The mapping of an AU to one or more CUs (by the decoder) is known implicitly at both the sending and the receiving terminals.

7.4.2.6 Compositor

The composition processes are assumed to be instantaneous for the purposes of the systems decoder model.

7.4.3 Managing Buffers: A Walkthrough

In this example, we assume that the model is used in a “push” scenario. In applications where non-real time content is to be delivered, flow control by suitable signaling may be established to request access units at the time they are needed at the receiving terminal. The mechanisms for doing so are application-dependent, and are not specified in ISO/IEC 14496.

The behaviors of the various elements in the SDM are modeled as follows:

- The sending terminal signals the required decoding buffer resources to the receiving terminal before starting the delivery. This is done as specified in 8.6.6 either explicitly, by requesting the decoding buffer sizes for individual elementary streams, or implicitly, by indicating a profile (see clause 15). The decoding buffer size is measured in bytes.
- The sending terminal models the behavior of the decoding buffers by making the following assumptions :
- Each decoding buffer is filled at the maximum bitrate specified for its associated elementary stream as long as data is available.
- At the instant of time corresponding to its DTS, an AU is instantaneously decoded and removed from the decoding buffer.
- At the instant of time corresponding to its DTS, a known amount of CUs corresponding to the just decoded AU are put in the composition memory.

The current CU is available to the compositor between instants of time corresponding to the CTS of the current CU and the CTS of the subsequent CU. If a subsequent CU does not exist, the current CU becomes unavailable at the end of lifetime of its data stream.

Using these assumptions on the buffer model, the sending terminal may freely use the space in the decoding buffers. For example, it may deliver data for several AUs of a stream, for non real time usage, to the receiving terminal, and pre-store them in the DB long before they have to be decoded (assuming sufficient space is available). Subsequently, the full delivery bandwidth may be used to transfer data of a real time stream just in time. The composition memory may be used, for example, as a reordering buffer. In the case of visual decoding, it may contain the decoded P-frames needed by a video decoder for the decoding of intermediate B-frames, before the arrival of the CTS of the latest P-frame.

8 Object Description Framework

8.1 Introduction

The scene description (specified in clause 9) and the elementary streams that convey streaming data are the basic building blocks of the architecture of ISO/IEC 14496-1. Elementary streams carry data for audio or visual objects as well as for the scene description itself. The object description framework provides the link between elementary streams and the scene description. The scene description declares the spatio-temporal relationship of audio-visual objects, while the object description framework specifies the elementary stream resources that provide the time-varying data for the scene. This indirection facilitates independent changes to the scene structure, the properties of the elementary streams (e.g. its encoding) and their delivery.

The object description framework consists of a set of descriptors that allows to identify, describe and properly associate elementary streams to each other and to audio-visual objects used in the scene description. Numeric identifiers, called ObjectDescriptorIDs, associate object descriptors to appropriate nodes in the scene description. Object descriptors are themselves conveyed in elementary streams to allow time stamped changes to the available set of object descriptors to be made.

Each object descriptor is itself a collection of descriptors that describe one or more elementary streams that are associated to a single node and that usually relate to a single audio or visual object. This allows to indicate a scaleable content representation as well as multiple alternative streams that convey the same content, e.g., in multiple qualities or different languages.

An elementary stream descriptor within an object descriptor identifies a single elementary stream with a numeric identifier, called ES_ID. Each elementary stream descriptor contains the information necessary to initiate and configure the decoding process for the elementary stream, as well as intellectual property identification. Optionally, additional information may be associated to a single elementary stream, most notably quality of service requirements for its transmission or a language indication. Both, object descriptors and elementary stream descriptors may use URLs to point to remote object descriptors or a remote elementary stream source, respectively.

The object description framework provides the hooks to implement intellectual property management and protection (IPMP) systems. IPMP information is conveyed both through IPMP descriptors as part of the object descriptor stream and through IPMP streams that carry time variant IPMP information. The structure of IPMP descriptors and IPMP streams is specified in this clause while their internal syntax and semantics and, hence, the operation of the IPMP system is outside the scope of ISO/IEC 14496.

Object content information allows the association of metadata with a whole presentation or with individual object descriptors or with elementary stream descriptors. A set of OCI descriptors is defined that either form an integral part of an object descriptor or elementary stream descriptor or are conveyed by means of a proper OCI stream that allows the conveyance of time variant object content information.

Access to ISO/IEC 14496 content is gained through an initial object descriptor that needs to be made available through means not defined in ISO/IEC 14496. The initial object descriptor in the simplest case points to the scene description stream and the corresponding object descriptor stream. The access scenario is outlined in 8.7.3.

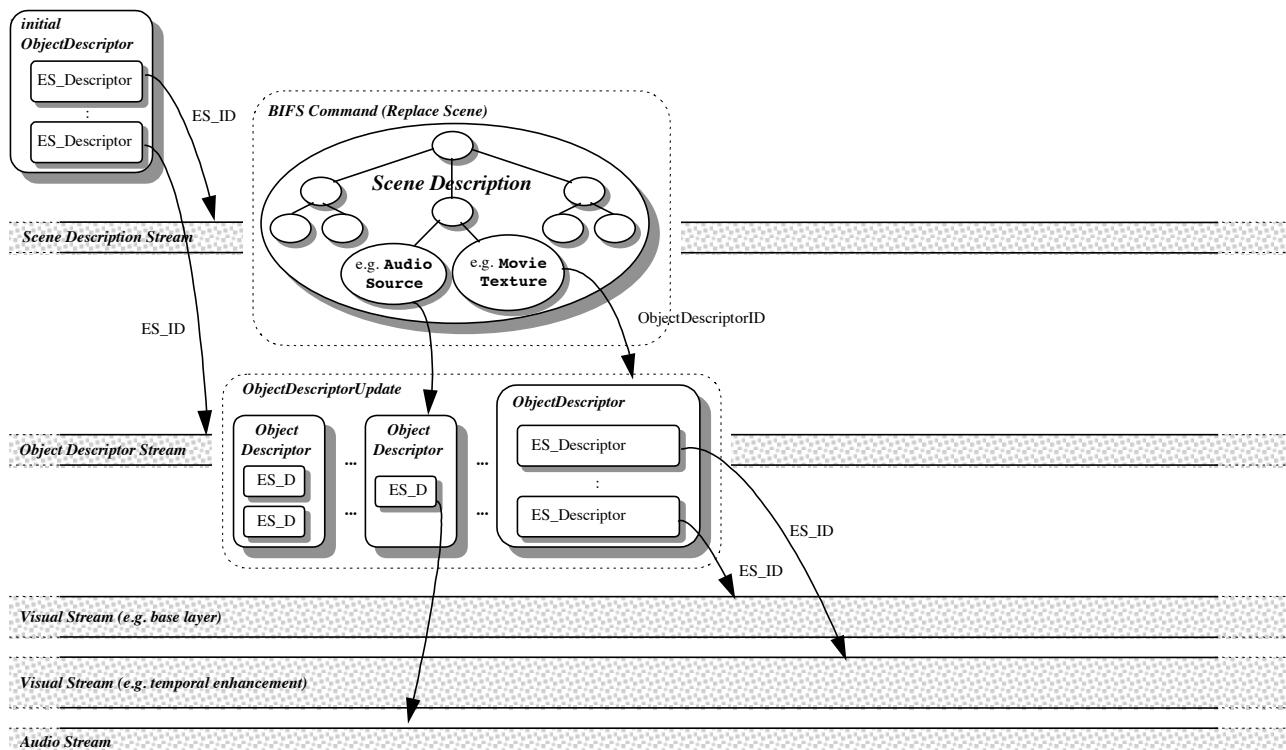


Figure 5 - Object descriptors linking scene description to elementary streams

The remainder of this clause is structured in the following way:

- Subclause 8.2 specifies the data structures on which the object descriptor framework is based.
- Subclause 8.3 specifies the concepts of the IPMP elements in the object description framework.
- Subclause 8.4 specifies the object content information elements in the object description framework.
- Subclause 8.5 specifies the object descriptor stream and the syntax and semantics of the command set that allows the update or removal of object descriptor components.
- Subclause 8.6 specifies the syntax and semantics of the object descriptor and its component descriptors.
- Subclause 8.7 specifies rules for object descriptor usage as well as the procedure to access content through object descriptors.
- Subclause 8.8 specifies the usage of the IPMP system interface.

8.2 Common data structures

8.2.1 Overview

The commands and descriptors defined in this subclause constitute self-describing classes, identified by unique class tags. Each class encodes explicitly its size in bytes. This facilitates future compatible extensions of the commands and descriptors. A class may be expanded with additional syntax elements that are ignored by an OD decoder that expects an earlier revision of a class. In addition, anywhere in a syntax where a set of tagged classes is expected it is permissible to intersperse expandable classes with unknown class tag values. These classes shall be skipped, using the encoded size information.

The remainder of this clause defines the syntax and semantics of the command and descriptor classes. Some commands and descriptors contain themselves a set of component descriptors. They are said to *aggregate a set of component descriptors*.

Table 1 - List of Class Tags for Descriptors

| Tag value | Tag name |
|------------------|---------------------------------------|
| 0x00 | Forbidden |
| 0x01 | ObjectDescrTag |
| 0x02 | InitialObjectDescrTag |
| 0x03 | ES_DescrTag |
| 0x04 | DecoderConfigDescrTag |
| 0x05 | DecSpecificInfoTag |
| 0x06 | SLConfigDescrTag |
| 0x07 | ContentIdentDescrTag |
| 0x08 | SupplContentIdentDescrTag |
| 0x09 | IPI_DescrPointerTag |
| 0x0A | IPMP_DescrPointerTag |
| 0x0B | IPMP_DescrTag |
| 0x0C | QoS_DescrTag |
| 0x0D | RegistrationDescrTag |
| 0x0E | ES_ID_IncTag |
| 0x0F | ES_ID_RefTag |
| 0x10 | MP4_IOD_Tag |
| 0x11 | MP4_OD_Tag |
| 0x12 | IPL_DescrPointerRefTag |
| 0x13 | ExtendedProfileLevelDescrTag |
| 0x14 | profileLevelIndicationIndexDescrTag |
| 0x15-0x3F | Reserved for ISO use |
| 0x40 | ContentClassificationDescrTag |
| 0x41 | KeyWordDescrTag |
| 0x42 | RatingDescrTag |
| 0x43 | LanguageDescrTag |
| 0x44 | ShortTextualDescrTag |
| 0x45 | ExpandedTextualDescrTag |
| 0x46 | ContentCreatorNameDescrTag |
| 0x47 | ContentCreationDateDescrTag |
| 0x48 | OCICreatorNameDescrTag |
| 0x49 | OCICreationDateDescrTag |
| 0x4A | SmpteCameraPositionDescrTag |
| 0x4B-0x5F | Reserved for ISO use (OCI extensions) |
| 0x60-0xBF | Reserved for ISO use |
| 0xC0-0xFE | User private |
| 0xFF | Forbidden |

8.2.2 BaseDescriptor

8.2.2.1 Syntax

```
abstract aligned(8) expandable(228-1) class BaseDescriptor : bit(8) tag=0 {
    // empty. To be filled by classes extending this class.
}
```

8.2.2.2 Semantics

This class is an abstract base class that is extended by the descriptor classes specified in 8.6. Each descriptor constitutes a self-describing class, identified by a unique class tag. This abstract base class establishes a common name space for the class tags of these descriptors. The values of the class tags are defined in Table 1. As an expandable class the size of each class instance in bytes is encoded and accessible through the instance variable `sizeOfInstance` (see 14.3.3).

A class that allows the aggregation of classes of type BaseDescriptor may actually aggregate any of the classes that extend BaseDescriptor.

NOTE — User private descriptors may have an internal structure, for example to identify the country or manufacturer that uses a specific descriptor. The tags and semantics for such user private descriptors may be managed by a registration authority if required.

The following additional symbolic names are introduced:

```
ExtDescrTagStartRange = 0x80
ExtDescrTagEndRange = 0xFE
OCIDescrTagStartRange = 0x40
OCIDescrTagEndRange = 0x5F
```

8.2.3 BaseCommand

8.2.3.1 Syntax

```
abstract aligned(8) expandable(228-1) class BaseCommand : bit(8) tag=0 {
    // empty. To be filled by classes extending this class.
}
```

8.2.3.2 Semantics

This class is an abstract base class that is extended by the command classes specified in 8.5.5. Each command constitutes a self-describing class, identified by a unique class tag. This abstract base class establishes a common name space for the class tags of these commands. The values of the class tags are defined in Table 2. As an expandable class the size of each class instance in bytes is encoded and accessible through the instance variable sizeOfInstance (see 14.3.3).

Table 2 - List of Class Tags for Commands

| Tag value | Tag name |
|-----------|---------------------------------|
| 0x00 | forbidden |
| 0x01 | ObjectDescrUpdateTag |
| 0x02 | ObjectDescrRemoveTag |
| 0x03 | ES_DescrUpdateTag |
| 0x04 | ES_DescrRemoveTag |
| 0x05 | IPMP_DescrUpdateTag |
| 0x06 | IPMP_DescrRemoveTag |
| 0x07 | ES_DescrRemoveRefTag |
| 0x08-0xBF | Reserved for ISO (command tags) |
| 0xC0-0xFE | User private |
| 0xFF | forbidden |

A class that allows the aggregation of classes of type BaseCommand may actually aggregate any of the classes that extend BaseCommand.

NOTE — User private commands may have an internal structure, for example to identify the country or manufacturer that uses a specific command. The tags and semantics for such user private command may be managed by a registration authority if required.

8.3 Intellectual Property Management and Protection (IPMP)

8.3.1 Overview

The intellectual property management and protection (IPMP) framework for ISO/IEC 14496 content consists of a normative interface that permits an ISO/IEC 14496 terminal to host one or more IPMP Systems. An IPMP System is a non-normative component that provides intellectual property management and protection functions for the terminal.

The IPMP interface consists of IPMP elementary streams and IPMP descriptors. The normative structure of IPMP elementary streams is specified in this subclause. IPMP descriptors are carried as part of an object descriptor stream and are specified in 8.6.14. The IPMP interface allows applications (or derivative application standards) to build specialized IPMP Systems. Alternatively, an application may choose not to use an IPMP System, thereby offering no management and protection features. The IPMP System uses the information carried by the IPMP elementary streams and descriptors to make protected ISO/IEC 14496 content available to the terminal. The detailed semantics and decoding process of the IPMP System are not in the scope of ISO/IEC 14496. The usage of the IPMP System Interface, however, is explained in 8.8.

8.3.2 IPMP Streams

8.3.2.1 Structure of the IPMP Stream

The IPMP stream is an elementary stream that passes time-varying information to one or more IPMP Systems. This is accomplished by periodically sending a sequence of IPMP messages along with the content at a period determined by the IPMP System(s).

8.3.2.2 Access Unit Definition

An IPMP access unit consists of one or more IPMP messages, as defined in 8.3.2.5. All IPMP messages that are to be processed at the same instant in time shall constitute a single access unit. Access units in IPMP streams shall be labeled and time-stamped by suitable means. This shall be done via the related flags and the composition time stamps, respectively, in the SL packet header (see 10.2.4). The composition time indicates the point in time at which an IPMP access unit becomes valid, i.e., when the embedded IPMP messages shall be evaluated. Decoding and composition time for an IPMP access unit shall always have the same value.

An access unit does not necessarily convey or update the complete set of IPMP messages that are currently required. In that case it just modifies the persistent state of the IPMP system. However, if an access unit conveys the complete set of IPMP messages required at a given point in time it shall set the `randomAccessPointFlag` in the SL packet header to '1' for this access unit. Otherwise, the `randomAccessPointFlag` shall be set to '0'.

NOTE — An SL packet with `randomAccessPointFlag=1` but with no IPMP messages in it indicates that at the current time instant no IPMP messages are required for operation.

8.3.2.3 Time Base for IPMP Streams

The time base associated to an IPMP stream shall be indicated by suitable means. This shall be done by means of object clock reference time stamps in the SL packet headers (see 10.2.4) for this stream or by indicating the elementary stream from which this IPMP stream inherits the time base (see 10.2.3). All time stamps in the SL-packetized IPMP stream refer to this time base.

An IPMP stream shall adhere to the same time base as the one or more content elementary streams to which it is associated (see 8.8). Consequently, an IPMP stream may not be associated to multiple content elementary streams that themselves adhere to different time bases.

8.3.2.4 IPMP Decoder Configuration

8.3.2.4.1 Syntax

```
class IPMPDecoderConfiguration extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {  
    // IPMP system specific configuration information  
}
```

8.3.2.4.2 Semantics

An IPMP system may require information to initialize its operation. This information shall be conveyed by extending the `decoderSpecificInfo` class as specified in 8.6.7. If utilized, `IPMPDecoderConfiguration` shall be conveyed in the `ES_Descriptor` declaring the IPMP stream.

8.3.2.5 IPMP message syntax and semantics

8.3.2.5.1 Syntax

```
abstract aligned(8) expandable(228-1) class IPMP_Message
{
    bit(16) IPMPS_Type;
    if (IPMPS_Type == 0) {
        bit(8) URLString[sizeOfInstance-2];
    } else {
        bit(8) IPMP_data[sizeOfInstance-2];
    }
}
```

8.3.2.5.2 Semantics

The `IPMP_Message` conveys control information for an IPMP System.

`IPMPS_Type` - the type of the IPMP System. A zero value does not correspond to an IPMP System, but shall indicate the presence of a URL. A non-zero value shall indicate a specific IPMP System Type. The values 0x0001-0x2000 are reserved for future ISO use. A Registration Authority, as designated by ISO, shall assign a unique valid value for this field for each specific IPMP System Type. The `IPMPS_Type` is used, for example, for distinguishing between IPMP systems from different companies.

`URLString[]` - contains a UTF-8 (ISO/IEC 10646-1) encoded URL that shall point to the location of a remote `IPMP_Message`. The `IPMPS_Type` of this `IPMP_Message` can be 0 or not. If 0, another URL is referenced. This process continues until an `IPMP_Message` with a non-zero `IPMPS_Type` is accessed.

`IPMP_data` - opaque data to control the IPMP System.

8.4 Object Content Information (OCI)

8.4.1 Overview

Audio-visual objects that are associated with elementary stream data through an object descriptor may have additional object content information attached to them. For this purpose, a set of OCI descriptors is defined in 8.6.18. OCI descriptors may directly be included as part of an object descriptor or `ES_Descriptor` as defined in 8.6.

In order to accommodate time variant OCI that is separable from the object descriptor stream, OCI descriptors may as well be conveyed in an OCI stream. An OCI stream is referred to through an `ES_Descriptor`, with the `streamType` field set to `OCI_Stream`. How OCI streams may be aggregated to object descriptors is defined in 8.7.1.3. The structure of the OCI stream is defined in this subclause.

8.4.2 OCI Streams

8.4.2.1 Structure of the OCI Stream

The OCI stream is an elementary stream that conveys time-varying object content information, termed OCI events. Each OCI event consists of a number of OCI descriptors.

8.4.2.2 Access Unit Definition

An OCI access unit consists of one or more `OCI_Events`, as described in 8.4.2.5. Access units in OCI elementary streams shall be labelled and time stamped by suitable means. This shall be done by means of the related flags and the composition time stamp, respectively, in the SL packet header (see 10.2.4). The composition time indicates the point in time when an OCI access unit becomes valid, i.e., when the embedded OCI events shall be added to the list of events. Decoding and composition time for an OCI access unit shall always have the same value.

An access unit may or may not convey or update the complete set of OCI events that are currently valid. In the latter case, it just modifies the persistent state of the OCI decoder. However, if an access unit conveys the complete set of OCI events valid at a given point in time it shall set the `randomAccessPointFlag` in the SL packet header to '1' for this access unit. Otherwise, the `randomAccessPointFlag` shall be set to '0'.

NOTE — An SL packet with `randomAccessPointFlag=1` but with no OCI events in it indicates that at the current time instant no valid OCI events exist.

8.4.2.3 Time Base for OCI Streams

The time base associated with an OCI stream shall be indicated by suitable means. This shall be done by the use of object clock reference time stamps in the SL packet headers (see 10.2.4) for this stream or by indicating the elementary stream from which this OCI stream inherits the time base (see 10.2.3). All time stamps in the SL-packetized OCI stream refer to this time base.

8.4.2.4 OCI Decoder Configuration

8.4.2.4.1 Syntax

```
class OCIDecoderConfiguration extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {  
    const bit(8) versionLabel = 0x01;  
}
```

8.4.2.4.2 Semantics

This information is needed to initialize operation of the OCI decoder. It shall be conveyed by extending the `decoderSpecificInfo` class as specified in 8.6.7. `OCIDecoderConfiguration` shall be conveyed in the `ES_Descriptor` declaring the OCI stream.

`versionLabel` – indicates the version of OCI specification used on the corresponding OCI data stream. Only the value `0x01` is allowed; all the other values are reserved.

8.4.2.5 OCI_Events syntax and semantics

8.4.2.5.1 Syntax

```
abstract aligned(8) expandable(228-1) class OCI_Event {  
    bit(15) eventID;  
    bit(1) absoluteTimeFlag;  
    bit(32) startingTime;  
    bit(32) duration;  
    OCI_Descriptor OCI_Descr[1 .. 255];  
}
```

8.4.2.5.2 Semantics

`eventID` – contains the identification number of the described event that is unique within the scope of this OCI stream.

`absoluteTimeFlag` – indicates the time base for `startingTime` as described below.

`startingTime` – indicates the starting time of the event in hours, minutes, seconds and hundredth of seconds. The format is 8 digits, the first 6 digits expressing hours, minutes and seconds with 4 bits each in binary coded decimal and the last two expressing hundredth of seconds in hexadecimal using 8 bits.

EXAMPLE — 02:36:45:89 is coded as “0x023645” concatenated with “0b0101.1001” (89 in binary), resulting to “0x02364559”.

If `absoluteTimeFlag` is set to zero, `startingTime` is relative to the object time base of the corresponding object. In that case it is the responsibility of the application to ensure that this object time base is conveyed such that `startingTime` can be identified unambiguously (see 10.2.7). If `absoluteTimeFlag` is set to one, `startingTime` is expressed as an absolute value, referring to wall clock time.

`duration` – contains the duration of the corresponding object in hours, minutes, seconds and hundredth of seconds. The format is 8 digits, the first 6 digits expressing hours, minutes and seconds with 4 bits each in binary coded decimal and the last two expressing hundredth of seconds in hexadecimal using 8 bits.

`OCI_Descr[]` – an array of one up to 255 `OCI_Descriptor` classes as specified in 8.6.18.2.

8.5 Object Descriptor Stream

8.5.1 Structure of the Object Descriptor Stream

Similar to the scene description, object descriptors are transported in a dedicated elementary stream, termed object descriptor stream. Within such a stream, it is possible to dynamically convey, update and remove complete object descriptors, or their component descriptors, the ES_Descriptors, and IPMP descriptors. The update mechanism allows, for example, to advertise new elementary streams for an audio-visual object as they become available, or to remove references to streams that are no longer available. Updates are time stamped to indicate the instant in time they take effect.

This subclause specifies the structure of the object descriptor elementary stream including the syntax and semantics of its constituent elements, the object descriptor commands (OD commands).

8.5.2 Access Unit Definition

An OD access unit consists of one or more OD commands, as described in 8.5.5. All OD commands that are to be processed at the same instant in time shall constitute a single access unit. Access units in object descriptor elementary streams shall be labelled and time stamped by suitable means. This shall be done by means of the related flags and the composition time stamp, respectively, in the SL packet header (see 10.2.4). The composition time indicates the point in time when an OD access unit becomes valid, i.e., when the embedded OD commands shall be executed. Decoding and composition time for an OD access unit shall always have the same value.

An access unit may not convey or update the complete set of object descriptors that are currently required. In that case it just modifies the persistent state of the object descriptor decoder. However, if an access unit conveys the complete set of object descriptors required at a given point in time it shall set the randomAccessPointFlag in the SL packet header to '1' for this access unit. Otherwise, the randomAccessPointFlag shall be set to '0'.

NOTE — An SL packet with randomAccessPointFlag=1 but with no OD commands in it indicates that at the current time instant no valid object descriptors exist.

8.5.3 Time Base for Object Descriptor Streams

The time base associated to an object descriptor stream shall be indicated by suitable means. This shall be done by means of object clock reference time stamps in the SL packet headers (see 10.2.4) for this stream or by indicating the elementary stream from which this object descriptor stream inherits the time base (see 10.2.3). All time stamps in the SL-packetized object descriptor stream refer to this time base.

8.5.4 OD Decoder Configuration

The object descriptor decoder does not require additional configuration information.

8.5.5 OD Command Syntax and Semantics

8.5.5.1 Overview

Object descriptors and their components as defined in 8.6 shall always be conveyed as part of one of the OD commands specified in this subclause. The commands describe the action to be taken on the components conveyed with the command, specifically 'update' or 'remove'. Each command affects one or more object descriptors, ES_Descriptors or IPMP descriptors.

8.5.5.2 ObjectDescriptorUpdate

8.5.5.2.1 Syntax

```
class ObjectDescriptorUpdate extends BaseCommand : bit(8) tag=ObjectDescrUpdateTag {
    ObjectDescriptorBase OD[1 .. 255];
}
```

8.5.5.2.2 Semantics

The `ObjectDescriptorUpdate` class conveys a list of new or updated object descriptors. If an object descriptor is updated, the streams referred to by the old object descriptor shall be closed and the streams referred to by the new object descriptor may be accessed by the content access procedure (see 8.7.3.6.2).

NOTE - The `ES_DescriptorUpdate` or `ES_DescriptorRemove` commands may be used to add or remove individual `ES_Descriptors` of an existing object descriptor.

`OD[]` – an array of object descriptors as defined in 8.6.3 and 8.6.4. The array shall have any number of one up to 255 elements.

8.5.5.3 ObjectDescriptorRemove

8.5.5.3.1 Syntax

```
class ObjectDescriptorRemove extends BaseCommand : bit(8) tag=ObjectDescrRemoveTag {
    bit(10) objectDescriptorId[(sizeOfInstance*8)/10];
}
```

8.5.5.3.2 Semantics

The `ObjectDescriptorRemove` class renders unavailable a set of object descriptors. The BIFS nodes associated to these object descriptors shall have no reference any more to the elementary streams that have been listed in the removed object descriptors. An `objectDescriptorID` that does not refer to a valid object descriptor is ignored.

NOTE — It is possible that a scene description node references an `OD_ID` which does not currently have an associated `OD`.

`ObjectDescriptorId[]` – an array of `ObjectDescriptorIDs` that indicates the object descriptors that are removed.

8.5.5.4 ES_DescriptorUpdate

8.5.5.4.1 Syntax

```
class ES_DescriptorUpdate extends BaseCommand : bit(8) tag=ES_DescrUpdateTag {
    bit(10) objectDescriptorId;
    ES_Descriptor esDescr[1 .. 255];
}
```

8.5.5.4.2 Semantics

The `ES_DescriptorUpdate` class conveys a list of new `ES_Descriptors` for the object descriptor labeled `objectDescriptorID`. `ES_Descriptors` with `ES_IDs` that have already been received within the same name scope shall be ignored.

To update the characteristics of an elementary stream, it is required that its original `ES_Descriptor` be removed and the changed `ES_Descriptor` be conveyed.

When an IPMP stream is added, the affected elementary streams, as defined in 8.8.2, shall be processed under the new IPMP conditions starting at the point in time that this `ES_DescriptorUpdate` command becomes valid (see 8.5.2).

`ES_DescriptorUpdate` shall not be applied on object descriptors that have set `URL_Flag` to '1' (see 8.6.3).

An elementary stream identified with a given `ES_ID` may be attached to more than one object descriptor. All corresponding `ES_Descriptors` referring to this `ES_ID` that are conveyed through either `ES_DescriptorUpdate` or `ObjectDescriptorUpdate` commands shall have identical content.

`objectDescriptorID` - identifies the object descriptor for which `ES_Descriptors` are updated. If the `objectDescriptorID` does not refer to any valid object descriptor, then this command is ignored.

`esDescr[]` – an array of `ES_Descriptors` as defined in 8.6.5. The array shall have any number of one up to 255 elements.

8.5.5.5 ES_DescriptorRemove

8.5.5.5.1 Syntax

```
class ES_DescriptorRemove extends BaseCommand : bit(8) tag=ES_DescrRemoveTag {
    bit(10) objectDescriptorId;
    aligned (8) bit(16) ES_ID[1..255];
}
```

8.5.5.5.2 Semantics

The `ES_DescriptorRemove` class removes the reference to an elementary stream from an object descriptor and renders this stream unavailable for nodes referencing this object descriptor.

When an IPMP stream is removed, the affected elementary streams, as defined in 8.8.2, shall be processed under the new IPMP conditions starting at the point in time that this `ES_DescriptorRemove` command becomes valid (see 8.5.2).

`ES_DescriptorRemove` shall not be applied on object descriptors that have set URL_Flag to '1' (see 8.6.3).

`objectDescriptorID` - identifies the object descriptor from which `ES_Descriptors` are removed. If the `objectDescriptorID` does not refer to a valid object descriptor in the same scope, then this command is ignored.

`ES_ID[]` – an array of `ES_IDS` that labels the `ES_Descriptors` to be removed from `objectDescriptorID`. If any of the `ES_IDS` do not refer to an `ES_Descriptor` currently referenced by the OD, then those `ES_IDS` are ignored. The array shall have any number of one up to 255 elements.

8.5.5.6 IPMP_DescriptorUpdate

8.5.5.6.1 Syntax

```
class IPMP_DescriptorUpdate extends BaseCommand : bit(8) tag=IPMP_DescrUpdateTag {
    IPMP_Descriptor ipmpDescr[1..255];
}
```

8.5.5.6.2 Semantics

The `IPMP_DescriptorUpdate` class conveys a list of new or updated `IPMP_Descriptors`. An `IPMP_Descriptor` identified by an `IPMP_DescriptorID` that has already been received within the same name scope shall be replaced by the new descriptor.

Updates to an `IPMP_Descriptor` shall be propagated at the time this `IPMP_DescriptorUpdate` becomes valid (see 8.5.2) to all IPMP Systems that refer to this `IPMP_Descriptor` through an `IPMP_DescriptorPointer` (see 8.6.13). The handling of the descriptors by the IPMP systems is not normative.

`IPMP_Descriptors` remain valid until they are replaced by another `IPMP_DescriptorUpdate` command or removed.

`ipmpDescr[]` – an array of `IPMP_Descriptor` as specified in 8.6.14.

8.5.5.7 IPMP_DescriptorRemove

8.5.5.7.1 Syntax

```
class IPMP_DescriptorRemove extends BaseCommand : bit(8) tag=IPMP_DescrRemoveTag {
    bit(8) IPMP_DescriptorID[1..255];
}
```

8.5.5.7.2 Semantics

The `IPMP_DescriptorRemove` class conveys a list of `IPMP_DescriptorIDs` that identify the `IPMP_Descriptors` that shall be removed.

The removal of `IPMP_Descriptors` shall be notified to all IPMP systems at the time this `IPMP_DescriptorRemove` becomes valid (see 8.5.2). The handling of the descriptors by the IPMP systems is not normative.

`IPMP_DescriptorID[]` – is a list of `IPMP_DescriptorIDs`.

8.6 Object Descriptor Components

8.6.1 Overview

Object descriptors contain various additional descriptors as their components, in order to describe individual elementary streams and their properties. They shall always be conveyed as part of one of the OD commands specified in the previous subclause. This subclause defines the syntax and semantics of object descriptors and their component descriptors.

8.6.2 ObjectDescriptorBase

8.6.2.1 Syntax

```
abstract class ObjectDescriptorBase extends BaseDescriptor : bit(8)
tag=[ObjectDescrTag..InitialObjectDescrTag] {
// empty. To be filled by classes extending this class.
}
```

8.6.2.2 Semantics

This is an abstract base class for the different types of object descriptor classes defined subsequently. The term “object descriptor” is used to generically refer to any such derived object descriptor class or instance thereof.

8.6.3 ObjectDescriptor

8.6.3.1 Syntax

```
class ObjectDescriptor extends ObjectDescriptorBase : bit(8) tag=ObjectDescrTag {
    bit(10) ObjectDescriptorID;
    bit(1) URL_Flag;
    const bit(5) reserved=0b1111.1;
    if (URL_Flag) {
        bit(8) URLlength;
        bit(8) URLstring[URLlength];
    } else {
        ES_Descriptor esDescr[1 .. 255];
        OCI_Descriptor ociDescr[0 .. 255];
        IPMP_DescriptorPointer ipmpDescrPtr[0 .. 255];
    }
    ExtensionDescriptor extDescr[0 .. 255];
}
```

8.6.3.2 Semantics

The `ObjectDescriptor` consists of three different parts.

The first part uniquely labels the object descriptor within its name scope (see 8.7.2.4) by means of an `objectDescriptorID`. Nodes in the scene description use `objectDescriptorID` to refer to the related object descriptor. An optional `URLstring` indicates that the actual object descriptor resides at a remote location.

The second part consists of a list of `ES_Descriptors`, each providing parameters for a single elementary as well as an optional set of object content information descriptors and pointers to IPMP descriptors for the contents for elementary stream content described in this object descriptor.

The third part is a set of optional descriptors that support the inclusion of future extensions as well as the transport of private data in a backward compatible way.

`objectDescriptorID` – This syntax element uniquely identifies the `ObjectDescriptor` within its name scope. The value 0 is forbidden and the value 1023 is reserved.

`URL_Flag` – a flag that indicates the presence of a `URLstring`.

`URLlength` – the length of the subsequent `URLstring` in bytes.

`URLstring[]` – A string with a UTF-8 (ISO/IEC 10646-1) encoded URL that shall point to another `ObjectDescriptor`. Only the content of this object descriptor shall be returned by the delivery entity upon access to this URL. Within the current name scope, the new object descriptor shall be referenced by the `objectDescriptorID` of the object descriptor carrying the `URLstring`. On name scopes see 8.7.2.4. Permissible URLs may be constrained by profile and levels as well as by specific delivery layers.

`esDescr[]` – an array of `ES_Descriptors` as defined in 8.6.5. The array shall have any number of one up to 255 elements.

`ociDescr[]` – an array of `OCI_Descriptors`, as defined in 8.6.18.2, that relates to the audio-visual object(s) described by this object descriptor. The array shall have any number of zero up to 255 elements.

`ipmpDescrPtr[]` – an array of `IPMP_DescriptorPointer`, as defined in 8.6.13, that points to the `IPMP_Descriptors` related to the elementary stream(s) described by this object descriptor. The array shall have any number of zero up to 255 elements.

`extDescr[]` – an array of `ExtensionDescriptors` as defined in 8.6.16. The array shall have any number of zero up to 255 elements.

8.6.4 InitialObjectDescriptor

8.6.4.1 Syntax

```
class InitialObjectDescriptor extends ObjectDescriptorBase : bit(8) tag=InitialObjectDescrTag
{
    bit(10) ObjectDescriptorID;
    bit(1) URL_Flag;
    bit(1) includeInlineProfileLevelFlag;
    const bit(4) reserved=0b1111;
    if (URL_Flag) {
        bit(8) URLlength;
        bit(8) URLstring[URLlength];
    } else {
        bit(8) ODProfileLevelIndication;
        bit(8) sceneProfileLevelIndication;
        bit(8) audioProfileLevelIndication;
        bit(8) visualProfileLevelIndication;
        bit(8) graphicsProfileLevelIndication;
        ES_Descriptor esDescr[1 .. 255];
        OCI_Descriptor ociDescr[0 .. 255];
        IPMP_DescriptorPointer ipmpDescrPtr[0 .. 255];
    }
    ExtensionDescriptor extDescr[0 .. 255];
}
```

8.6.4.2 Semantics

The `InitialObjectDescriptor` is a variation of the `ObjectDescriptor` specified in the previous subclause that allows to signal profile and level information for the content referred by it. It shall be used to gain initial access to ISO/IEC 14496 content (see 8.7.3).

Profile and level information indicated in the `InitialObjectDescriptor` indicates the profile and level supported by at least the first base layer stream (i.e. an elementary stream with a `streamDependenceFlag` set to 0) in each object descriptor depending on this initial object descriptor.

ISO/IEC 14496-1:2001(E)

`objectDescriptorId` – This syntax element uniquely identifies the `InitialObjectDescriptor` within its name scope (see 8.7.2.4). The value 0 is forbidden and the value 1023 is reserved.

`URL_Flag` – a flag that indicates the presence of a `URLstring`.

`includeInlineProfileLevelFlag` – a flag that, if set to one, indicates that the subsequent profile indications take into account the resources needed to process any content that might be inlined.

`URLlength` – the length of the subsequent `URLstring` in bytes.

`URLstring[]` – A string with a UTF-8 (ISO/IEC 10646-1) encoded URL that shall point to another `InitialObjectDescriptor`. Only the content of this object descriptor shall be returned by the delivery entity upon access to this URL. Within the current name scope, the new object descriptor shall be referenced by the `objectDescriptorId` of the object descriptor carrying the `URLstring`. On name scopes see 8.7.2.4. Permissible URLs may be constrained by profile and levels as well as by specific delivery layers.

`ODProfileLevelIndication` – an indication as defined in Table 3 of the object descriptor profile and level required to process the content associated with this `InitialObjectDescriptor`.

Table 3 - ODProfileLevelIndication Values

| Value | Profile | Level |
|-----------|---------------------------|-------|
| 0x00 | Forbidden | - |
| 0x01-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no OD profile specified | - |
| 0xFF | no OD capability required | - |

NOTE — Usage of the value 0xFE indicates that the content described by this `InitialObjectDescriptor` does not comply to any OD profile specified in ISO/IEC 14496-1. Usage of the value 0xFF indicates that none of the OD profile capabilities are required for this content.

`sceneProfileLevelIndication` – an indication as defined in Table 4 of the scene graph profile and level required to process the content associated with this `InitialObjectDescriptor`.

Table 4 - sceneProfileLevelIndication Values

| Value | Profile | Level |
|-----------|------------------------------------|-------|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Simple2D profile | L1 |
| 0x02-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no scene graph profile specified | - |
| 0xFF | no scene graph capability required | - |

NOTE — Usage of the value 0xFE indicates that the content described by this `InitialObjectDescriptor` does not comply to any scene graph profile specified in ISO/IEC 14496-1. Usage of the value 0xFF indicates that none of the scene graph profile capabilities are required for this content.

`audioProfileLevelIndication` – an indication as defined in Table 5 of the audio profile and level required to process the content associated with this `InitialObjectDescriptor`.

Table 5 - audioProfileLevelIndication Values

| Value | Profile | Level |
|-------|----------------------|-------|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Main Profile | L1 |
| 0x02 | Main Profile | L2 |
| 0x03 | Main Profile | L3 |

| | | |
|-----------|------------------------------|----|
| 0x04 | Main Profile | L4 |
| 0x05 | Scalable Profile | L1 |
| 0x06 | Scalable Profile | L2 |
| 0x07 | Scalable Profile | L3 |
| 0x08 | Scalable Profile | L4 |
| 0x09 | Speech Profile | L1 |
| 0x0A | Speech Profile | L2 |
| 0x0B | Synthesis Profile | L1 |
| 0x0C | Synthesis Profile | L2 |
| 0x0D | Synthesis Profile | L3 |
| 0x0E-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no audio profile specified | - |
| 0xFF | no audio capability required | - |

NOTE — Usage of the value 0xFE indicates that the content described by this InitialObjectDescriptor does not comply to any audio profile specified in ISO/IEC 14496-3. Usage of the value 0xFF indicates that none of the audio profile capabilities are required for this content.

`visualProfileLevelIndication` – an indication as defined in Table 6 of the visual profile and level required to process the content associated with this `InitialObjectDescriptor`.

Table 6 - visualProfileLevelIndication Values

| Value | Profile | Level |
|-----------|-------------------------------|-------|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Simple | L3 |
| 0x02 | Simple | L2 |
| 0x03 | Simple | L1 |
| 0x04 | Simple Scalable | L2 |
| 0x05 | Simple Scalable | L1 |
| 0x06 | Core | L2 |
| 0x07 | Core | L1 |
| 0x08 | Main | L4 |
| 0x09 | Main | L3 |
| 0x0A | Main | L2 |
| 0x0B | N-Bit | L2 |
| 0x0C | Hybrid | L2 |
| 0x0D | Hybrid | L1 |
| 0x0E | Basic Animated Texture | L2 |
| 0x0F | Basic Animated Texture | L1 |
| 0x10 | Scalable Texture | L3 |
| 0x11 | Scalable Texture | L2 |
| 0x12 | Scalable Texture | L1 |
| 0x13 | Simple Face Animation | L2 |
| 0x14 | Simple Face Animation | L1 |
| 0x15-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no visual profile specified | - |
| 0xFF | no visual capability required | - |

NOTE — Usage of the value 0xFE indicates that the content described by this `InitialObjectDescriptor` does not comply to any visual profile specified in ISO/IEC 14496-2. Usage of the value 0xFF indicates that none of the visual profile capabilities are required for this content.

`graphicsProfileLevelIndication` – an indication as defined in Table 7 of the graphics profile and level required to process the content associated with this `InitialObjectDescriptor`.

Table 7 - `graphicsProfileLevelIndication` Values

| Value | Profile | Level |
|--------------|---------------------------------|--------------|
| 0x00 | Reserved for ISO use | |
| 0x01 | Simple2D profile | L1 |
| 0x02-0x7F | reserved for ISO use | |
| 0x80-0xFD | user private | |
| 0xFE | no graphics profile specified | |
| 0xFF | no graphics capability required | |

NOTE — Usage of the value 0xFE may indicate that the content described by this `InitialObjectDescriptor` does not comply to any conformance point specified in ISO/IEC 14496-1. Usage of the value 0xFF indicates that none of the graphics profile capabilities are required for this content.

`esDescr[]` – an array of `ES_Descriptors` as defined in 8.6.5. The array shall have any number of one up to 255 elements.

`ociDescr[]` – an array of `OCI_Descriptors` as defined in 8.6.18.2 that relates to the set of audio-visual objects that are described by this initial object descriptor. The array shall have any number of zero up to 255 elements.

`ipmpDescrPtr[]` – an array of `IPMP_DescriptorPointer`, as defined in 8.6.13, that points to the `IPMP_Descriptors` related to the elementary stream(s) described by this object descriptor. The array shall have any number of zero up to 255 elements.

`extDescr[]` – an array of `ExtensionDescriptors` as defined in 8.6.16. The array shall have any number of zero up to 255 elements.

8.6.5 ES_Descriptor

8.6.5.1 Syntax

```
class ES_Descriptor extends BaseDescriptor : bit(8) tag=ES_DescrTag {
    bit(16) ES_ID;
    bit(1) streamDependenceFlag;
    bit(1) URL_Flag;
    bit(1) OCRstreamFlag;
    bit(5) streamPriority;
    if (streamDependenceFlag)
        bit(16) dependsOn_ES_ID;
    if (URL_Flag) {
        bit(8) URLlength;
        bit(8) URLstring[URLlength];
    }
    if (OCRstreamFlag)
        bit(16) OCR_ES_Id;
    DecoderConfigDescriptor decConfigDescr;
    SLConfigDescriptor slConfigDescr;
    IPI_DescrPointer ipiPtr[0 .. 1];
    IP_IdentificationDataSet ipIDS[0 .. 255];
    IPMP_DescriptorPointer ipmpDescrPtr[0 .. 255];
    LanguageDescriptor langDescr[0 .. 255];
    QoS_Descriptor qosDescr[0 .. 1];
    RegistrationDescriptor regDescr[0 .. 1];
    ExtensionDescriptor extDescr[0 .. 255];
}
```

8.6.5.2 Semantics

The `ES_Descriptor` conveys all information related to a particular elementary stream and has three major parts.

The first part consists of the `ES_ID` which is a unique reference to the elementary stream within its name scope (see 8.7.2.4), a mechanism to describe dependencies of elementary streams within the scope of the parent object descriptor and an optional URL string. Dependencies and usage of URLs are specified in 8.7.

The second part consists of the component descriptors which convey the parameters and requirements of the elementary stream.

The third part is a set of optional extension descriptors that support the inclusion of future extensions as well as the transport of private data in a backward compatible way.

`ES_ID` – This syntax element provides a unique label for each elementary stream within its name scope. The values 0 and 0xFFFF are reserved.

`streamDependenceFlag` – If set to one indicates that a `dependsOn_ES_ID` will follow.

`URL_Flag` – if set to 1 indicates that a `URLstring` will follow.

`OCRstreamFlag` – indicates that an `OCR_ES_ID` syntax element will follow.

`streamPriority` – indicates a relative measure for the priority of this elementary stream. An elementary stream with a higher `streamPriority` is more important than one with a lower `streamPriority`. The absolute values of `streamPriority` are not normatively defined.

`dependsOn_ES_ID` – is the `ES_ID` of another elementary stream on which this elementary stream depends. The stream with `dependsOn_ES_ID` shall also be associated to the same object descriptor as the current `ES_Descriptor`.

`URLlength` – the length of the subsequent `URLstring` in bytes.

`URLstring[]` – contains a UTF-8 (ISO/IEC 10646-1) encoded URL that shall point to the location of an SL-packetized stream by name. The parameters of the SL-packetized stream that is retrieved from the URL are fully specified in this `ES_Descriptor`. See also 8.7.3.3. Permissible URLs may be constrained by profile and levels as well as by specific delivery layers.

`OCR_ES_ID` – indicates the `ES_ID` of the elementary stream within the name scope (see 8.7.2.4) from which the time base for this elementary stream is derived. Circular references between elementary streams are not permitted.

`decConfigDescr` – is a `DecoderConfigDescriptor` as specified in 8.6.6.

`slConfigDescr` – is an `SLConfigDescriptor` as specified in 8.6.8.

`ipiPtr[]` – an array of zero or one `IPI_DescrPointer` as specified in 8.6.12.

`ipIDS[]` – an array of zero or more `IP_IdentificationDataSet` as specified in 8.6.9.

Each `ES_Descriptor` shall have either one `IPI_DescrPointer` or zero up to 255 `IP_IdentificationDataSet` elements. This allows to unambiguously associate an IP Identification to each elementary stream.

`ipmpDescrPtr[]` – an array of `IPMP_DescriptorPointer`, as defined in 8.6.13, that points to the `IPMP_Descriptors` related to the elementary stream described by this `ES_Descriptor`. The array shall have any number of zero up to 255 elements.

`langDescr[]` – an array of zero or one `LanguageDescriptor` structures as specified in 8.6.18.6. It indicates the language attributed to this elementary stream.

NOTE – Multichannel audio streams may be treated as one elementary stream with one `ES_Descriptor` by ISO/IEC 14496. In that case different languages present in different channels of the multichannel stream are not identifiable with a `LanguageDescriptor`.

`qosDescr[]` – an array of zero or one `QoS_Descriptor` as specified in 8.6.15.

`extDescr[]` – an array of `ExtensionDescriptor` structures as specified in 8.6.16.

8.6.6 DecoderConfigDescriptor

8.6.6.1 Syntax

```
class DecoderConfigDescriptor extends BaseDescriptor : bit(8) tag=DecoderConfigDescrTag {
    bit(8) objectTypeIndication;
    bit(6) streamType;
    bit(1) upStream;
    const bit(1) reserved=1;
    bit(24) bufferSizeDB;
    bit(32) maxBitrate;
    bit(32) avgBitrate;
    DecoderSpecificInfo decSpecificInfo[0 .. 1];
    profileLevelIndicationIndexDescriptor profileLevelIndicationIndexDescr [0..255];
}
```

8.6.6.2 Semantics

The `DecoderConfigDescriptor` provides information about the decoder type and the required decoder resources needed for the associated elementary stream. This is needed at the receiving terminal to determine whether it is able to decode the elementary stream. A stream type identifies the category of the stream while the optional decoder specific information descriptor contains stream specific information for the set up of the decoder in a stream specific format that is opaque to this layer.

`objectTypeIndication` – an indication of the object or scene description type that needs to be supported by the decoder for this elementary stream as per Table 8. For `streamType` values other than `audioStream` and `visualStream`, the `objectTypeIndication` shall be set to `0xFF`, indicating that no object type is specified.

Table 8 - objectTypeIndication Values

| Value | ObjectTypeIndication Description |
|--------------|---|
| 0x00 | Forbidden |
| 0x01 | Systems ISO/IEC 14496-1 ^a |
| 0x02 | Systems ISO/IEC 14496-1 ^b |
| 0x03-0x1F | reserved for ISO use |
| 0x20 | Visual ISO/IEC 14496-2 ^c |
| 0x21-0x3F | reserved for ISO use |
| 0x40 | Audio ISO/IEC 14496-3 ^d |
| 0x41-0x5F | reserved for ISO use |
| 0x60 | Visual ISO/IEC 13818-2 Simple Profile |
| 0x61 | Visual ISO/IEC 13818-2 Main Profile |
| 0x62 | Visual ISO/IEC 13818-2 SNR Profile |
| 0x63 | Visual ISO/IEC 13818-2 Spatial Profile |
| 0x64 | Visual ISO/IEC 13818-2 High Profile |
| 0x65 | Visual ISO/IEC 13818-2 422 Profile |
| 0x66 | Audio ISO/IEC 13818-7 Main Profile |
| 0x67 | Audio ISO/IEC 13818-7 LowComplexity Profile |
| 0x68 | Audio ISO/IEC 13818-7 Scaleable Sampling Rate Profile |
| 0x69 | Audio ISO/IEC 13818-3 |
| 0x6A | Visual ISO/IEC 11172-2 |
| 0x6B | Audio ISO/IEC 11172-3 |
| 0x6C | Visual ISO/IEC 10918-1 |
| 0x6D - 0xBF | reserved for ISO use |
| 0xC0 - 0xFE | user private |
| 0xFF | no object type specified |

- ^a This object type shall be used for all streamTypes defined in ISO/IEC 14496-1 except IPMP streams.
- ^b Includes associated Amendment(s) and Corrigendum(a).
- ^c Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-2 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-2, Annex K.
- ^d Includes associated Amendment(s) and Corrigendum(a). The actual object types are defined in ISO/IEC 14496-3 and are conveyed in the DecoderSpecificInfo as specified in ISO/IEC 14496-3 subpart 1 subclause 6.2.1.

`streamType` – conveys the type of this elementary stream as per Table 9.

Table 9 - streamType Values

| streamType value | Stream type description |
|-------------------------|-------------------------------------|
| 0x00 | Forbidden |
| 0x01 | ObjectDescriptorStream (see 8.5) |
| 0x02 | ClockReferenceStream (see 10.2.5) |
| 0x03 | SceneDescriptionStream (see 9.2.1) |
| 0x04 | VisualStream |
| 0x05 | AudioStream |
| 0x06 | MPEG7Stream |
| 0x07 | IPMPStream (see 8.3.2) |
| 0x08 | ObjectContentInfoStream (see 8.4.2) |
| 0x09 | MPEGJStream |
| 0x0A - 0x1F | reserved for ISO use |
| 0x20 - 0x3F | user private |

`upStream` – indicates that this stream is used for upstream information.

`bufferSizeDB` – is the size of the decoding buffer for this elementary stream in byte.

`maxBitrate` – is the maximum bitrate in bits per second of this elementary stream in any time window of one second duration.

`avgBitrate` – is the average bitrate in bits per second of this elementary stream. For streams with variable bitrate this value shall be set to zero.

`decSpecificInfo[]` – an array of zero or one decoder specific information classes as specified in 8.6.7.

`ProfileLevelIndicationIndexDescr [0..255]` – an array of unique identifiers for a set of profile and level indications as carried in the `ExtensionProfileLevelDescr` defined in clause 8.6.19.

8.6.7 DecoderSpecificInfo

8.6.7.1 Syntax

```
abstract class DecoderSpecificInfo extends BaseDescriptor : bit(8) tag=DecSpecificInfoTag
{
    // empty. To be filled by classes extending this class.
}
```

8.6.7.2 Semantics

The decoder specific information constitutes an opaque container with information for a specific media decoder. The existence and semantics of decoder specific information depends on the values of `DecoderConfigDescriptor.streamType` and `DecoderConfigDescriptor.objectTypeIndication`.

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For values of DecoderConfigDescriptor.objectTypeIndication that refer to streams complying with ISO/IEC 14496-2 the syntax and semantics of decoder specific information are defined in Annex K of that part.

For values of DecoderConfigDescriptor.objectTypeIndication that refer to streams complying with ISO/IEC 14496-3 the syntax and semantics of decoder specific information are defined in section 1, clause 1.6 of that part.

For values of DecoderConfigDescriptor.objectTypeIndication that refer to scene description streams the semantics of decoder specific information is defined in 9.2.1.2.

For values of DecoderConfigDescriptor.objectTypeIndication that refer to streams complying with ISO/IEC 13818-7 the decoder specific information consists of the ADIF -header if it is present (or none if it is not present) and an access unit is a „raw_data_block()“ as defined in ISO/IEC 13818-7.

For values of DecoderConfigDescriptor.objectTypeIndication that refer to streams complying with ISO/IEC 13818-3 the decoder specific information is empty since all necessary data is in the bitstream frames itself. The access units in this case are the „frame()“ bitstream element as is defined in ISO/IEC 11172-3.

For values of DecoderConfigDescriptor.objectTypeIndication that refer to streams complying with ISO/IEC 10918-1, the decoder specific information is:

```
class JPEG_DecoderConfig extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {
    int(16) headerLength;
    int(16) Xdensity;
    int(16) Ydensity;
    int(8) numComponents;
}
```

with

headerLength – indicates the number of bytes to skip from the beginning of the stream to find the first pixel of the image.

Xdensity and Ydensity – specify the pixel aspect ratio.

numComponents – indicates whether the image has Y component only or is Y, Cr, Cb. It shall be equal to 1 or 3.

8.6.8 SLConfigDescriptor

This descriptor defines the configuration of the sync layer header for this elementary stream. The specification of this descriptor is provided together with the specification of the sync layer in 10.2.3.

8.6.9 IP_IdentificationDataSet

8.6.9.1 Syntax

```
abstract class IP_IdentificationDataSet extends BaseDescriptor
    : bit(8) tag=ContentIdentDescrTag..SupplContentIdentDescrTag
{
    // empty. To be filled by classes extending this class.
}
```

8.6.9.2 Semantics

This class is an abstract base class that is extended by the descriptor classes that implement IP identification. A descriptor that allows to aggregate classes of type IP_IdentificationDataSet may actually aggregate any of the classes that extend IP_IdentificationDataSet.

8.6.10 ContentIdentificationDescriptor

8.6.10.1 Syntax

```
class ContentIdentificationDescriptor extends IP_IdentificationDataSet
    : bit(8) tag=ContentIdentDescrTag
```

```

{
    const bit(2) compatibility=0;
    bit(1)      contentTypeFlag;
    bit(1)      contentIdentifierFlag;
    bit(1)      protectedContent;
    bit(3)      reserved = 0b111;
    if (contentTypeFlag)
        bit(8)  contentType;
    if (contentIdentifierFlag) {
        bit(8)  contentIdentifierType;
        bit(8)  contentIdentifier[sizeOfInstance-2-contentTypeFlag];
    }
}

```

8.6.10.2 Semantics

The content identification descriptor is used to identify content. All types of elementary streams carrying content can be identified using this mechanism. The content types include audio, visual and scene description data. Multiple content identification descriptors may be associated to one elementary stream. These descriptors shall never be detached from the ES_Descriptor.

`compatibility` – must be set to 0.

`contentTypeFlag` – flag to indicate if a definition of the type of content is available.

`contentIdentifierFlag` – flag to indicate presence of creation ID.

`protectedContent` - if set to one indicates that the elementary streams that refer to this IP_IdentificationDataSet are protected by a method outside the scope of ISO/IEC 14496. The behavior of the terminal compliant with the ISO/IEC 14496 specifications when processing such streams is undefined.

`contentType` – defines the type of content using one of the values specified in Table 10.

Table 10 - contentType Values

| | |
|-------|---|
| 0 | Audio-visual |
| 1 | Book |
| 2 | Serial |
| 3 | Text |
| 4 | Item or Contribution (e.g. article in book or serial) |
| 5 | Sheet music |
| 6 | Sound recording or music video |
| 7 | Still Picture |
| 8 | Musical Work |
| 9-254 | Reserved for ISO use |
| 255 | Others |

`contentIdentifierType` – defines a type of content identifier using one of the values specified in Table 11.

Table 11 - contentIdentifierType Values

| | | |
|---|--------|---|
| 0 | ISAN | International Standard Audio-Visual Number |
| 1 | ISBN | International Standard Book Number |
| 2 | ISSN | International Standard Serial Number |
| 3 | SICI | Serial Item and Contribution Identifier |
| 4 | BICI | Book Item and Component Identifier |
| 5 | ISMN | International Standard Music Number |
| 6 | ISRC | International Standard Recording Code |
| 7 | ISWC-T | International Standard Work Code (Tunes) |
| 8 | ISWC-L | International Standard Work Code (Literature) |

| | | |
|--------|----------------------|---------------------------|
| 9 | SPIFF | Still Picture ID |
| 10 | DOI | Digital Object Identifier |
| 11-255 | Reserved for ISO use | |

contentIdentifier – international code identifying the content according to the preceding contentIdentifierType.

8.6.11 SupplementaryContentIdentificationDescriptor

8.6.11.1 Syntax

```
class SupplementaryContentIdentificationDescriptor extends
    IP_IdentificationDataSet : bit(8) tag= SupplContentIdentDescrTag
{
    bit(24) languageCode;
    bit(8) supplContentIdentifierTitleLength;
    bit(8) supplContentIdentifierTitle[supplContentIdentifierTitleLength];
    bit(8) supplContentIdentifierValueLength;
    bit(8) supplContentIdentifierValue[supplContentIdentifierValueLength];
}
```

8.6.11.2 Semantics

The supplementary content identification descriptor is used to provide extensible identifiers for content that are qualified by a language code. Multiple supplementary content identification descriptors may be associated to one elementary stream. These descriptors shall never be detached from the ES_Descriptor.

language code – This 24 bits field contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields.

supplementaryContentIdentifierTitleLength – indicates the length of the subsequent supplementaryContentIdentifierTitle in bytes.

supplementaryContentIdentifierTitle – identifies the title of a supplementary content identifier that may be used when a numeric content identifier (see 8.6.10) is not available.

supplementaryContentIdentifierValueLength – indicates the length of the subsequent supplementaryContentIdentifierValue in bytes.

supplementaryContentIdentifierValue – identifies the value of a supplementary content identifier associated to the preceding supplementaryContentIdentifierTitle.

8.6.12 IPI_DescrPointer

8.6.12.1 Syntax

```
class IPI_DescrPointer extends BaseDescriptor : bit(8) tag=IPI_DescrPointerTag {
    bit(16) IPI_ES_Id;
}
```

8.6.12.2 Semantics

The IPI_DescrPointer class contains a reference to the elementary stream that includes the IP_IdentificationDataSets that are valid for this stream. This indirect reference mechanism allows to convey such descriptors only in one elementary stream while making references to it from any ES_Descriptor that shares the same information.

ES_Descriptors for elementary streams that are intended to be accessible regardless of the availability of a referred stream shall explicitly include their IP_IdentificationDataSets instead of using an IPI_DescrPointer.

IPI_ES_Id – the **ES_ID** of the elementary stream whose **ES_Descriptor** contains the IP Information valid for this elementary stream. If the **ES_Descriptor** for **IPI_ES_Id** is not available, the IPI status of this elementary stream is undefined.

8.6.13 IPMP_DescriptorPointer

8.6.13.1 Syntax

```
class IPMP_DescriptorPointer extends BaseDescriptor : bit(8) tag=IPMP_DescrPointerTag {
    bit(8) IPMP_DescriptorID;
}
```

8.6.13.2 Semantics

IPMP_DescriptorID - ID of the referenced **IPMP_Descriptor** (see 8.6.14).

Presence of this descriptor in an object descriptor indicates that all streams referred to by embedded **ES_Descriptors** are subject to protection and management by the IPMP System specified in the referenced **IPMP_Descriptor**.

Presence of this descriptor in an **ES_Descriptor** indicates that the stream associated with this descriptor is subject to intellectual property management and protection by the IPMP System specified in the referenced **IPMP_Descriptor**.

8.6.14 IPMP Descriptor

8.6.14.1 Syntax

```
class IPMP_Descriptor() extends BaseDescriptor : bit(8) IPMP_DescrTag {
    bit(8) IPMP_DescriptorID;
    unsigned int(16) IPMPS_Type;
    if (IPMPS_Type == 0) {
        bit(8) urlString[sizeOfInstance-3];
    } else {
        bit(8) IPMP_data[sizeOfInstance-3];
    }
}
```

8.6.14.2 Semantics

The **IPMP_Descriptor** conveys IPMP information to an IPMP System. **IPMP_Descriptors** are conveyed in object descriptor streams via **IPMP_DescriptorUpdates** as specified in 8.5.5.6. They are not directly included in object descriptors or **ES_Descriptors**. **IPMP_Descriptors** are referenced by object descriptors or **ES_Descriptors** using **IPMP_DescriptorPointers** (see 8.6.13). An **IPMP_Descriptor** may be referenced by multiple object descriptors or **ES_Descriptors**.

IPMP_DescriptorID - a unique ID for this IPMP descriptor within its name scope (see 8.7.2.4).

IPMPS_Type - the type of the IPMP System. A zero value does not correspond to an IPMP System but is used to indicate the presence of a URL. A Registration Authority designated by ISO shall assign valid values for this field.

URLString[] - contains a UTF-8 (ISO/IEC 10646-1) encoded URL that shall point to the location of a remote **IPMP_Descriptor**. The **IPMPS_Type** of this **IPMP_Descriptor** can be 0 or not. If 0, another URL is referenced. This process continues until an **IPMP_Descriptor** with a non-zero **IPMPS_Type** is accessed.

IPMP_data - opaque data to control the IPMP System.

8.6.14.3 Implementation of a Registration Authority (RA)

ISO/IEC JTC 1/SC 29 shall issue a call for nominations from Member Bodies of ISO or National Committees of IEC in order to identify suitable organizations that will serve as the Registration Authority for the **IPMPS_Type** as defined in this clause. The selected organization shall serve as the Registration Authority. The so-named

Registration Authority shall execute its duties in compliance with Annex H of the JTC 1 Directives. The registered IPMPS_Type is hereafter referred to as the Registered Identifier (RID).

Upon selection of the Registration Authority, JTC 1 shall require the creation of a Registration Management Group (RMG) that will review appeals filed by organizations whose request for an RID to be used in conjunction with ISO/IEC 14496 has been denied by the Registration Authority.

Annex D provides information on the procedure for registering a unique IPMPS_Type value.

8.6.15 QoS_Descriptor

8.6.15.1 Syntax

```
class QoS_Descriptor extends BaseDescriptor : bit(8) tag=QoS_DescrTag {
    bit(8) predefined;
    if (predefined==0) {
        QoS_Qualifier qualifiers[];
    }
}
```

8.6.15.2 Semantics

The QoS_descriptor conveys the requirements that the ES has on the transport channel and a description of the traffic that this ES will generate. A set of predefined values is to be determined; customized values can be used by setting the predefined field to 0.

predefined – a value different from zero indicates a predefined QoS profile according to Table 12.

Table 12 - Predefined QoS Profiles

| predefined value | description |
|-------------------------|--------------------|
| 0x00 | Custom |
| 0x01 - 0xff | Reserved |

qualifier – an array of one or more QoS_Qualifiers.

8.6.15.3 QoS_Qualifier

8.6.15.3.1 Syntax

```
abstract aligned(8) expandable(228-1) class QoS_Qualifier : bit(8) tag=0x01..0xff {
    // empty. To be filled by classes extending this class.
}

class QoS_Qualifier_MAX_DELAY extends QoS_Qualifier : bit(8) tag=0x01 {
    unsigned int(32) MAX_DELAY;
}

class QoS_Qualifier_PREF_MAX_DELAY extends QoS_Qualifier : bit(8) tag=0x02 {
    unsigned int(32) PREF_MAX_DELAY;
}

class QoS_Qualifier_LOSS_PROB extends QoS_Qualifier : bit(8) tag=0x03 {
    double(32) LOSS_PROB;
}

class QoS_Qualifier_MAX_GAP_LOSS extends QoS_Qualifier : bit(8) tag=0x04 {
    unsigned int(32) MAX_GAP_LOSS;
}

class QoS_Qualifier_MAX_AU_SIZE extends QoS_Qualifier : bit(8) tag=0x41 {
    unsigned int(32) MAX_AU_SIZE;
}

class QoS_Qualifier_AVG_AU_SIZE extends QoS_Qualifier : bit(8) tag=0x42 {
```

```

    unsigned int(32) AVG_AU_SIZE;
}

class QoS_Qualifier_MAX_AU_RATE extends QoS_Qualifier : bit(8) tag=0x43 {
    unsigned int(32) MAX_AU_RATE;
}

```

8.6.15.3.2 Semantics

QoS qualifiers are defined as derived classes from the abstract `QoS_Qualifier` class. They are identified by means of their class tag. Unused tag values up to and including 0x7F are reserved for ISO use. Tag values from 0x80 up to and including 0xFE are user private. Tag values 0x00 and 0xFF are forbidden.

`MAX_DELAY` – Maximum end to end delay for the stream in microseconds.

`PREF_MAX_DELAY` – Preferred end to end delay for the stream in microseconds.

`LOSS_PROB` – Allowable loss probability of any single AU as a fractional value between 0.0 and 1.0.

`MAX_GAP_LOSS` – Maximum allowable number of consecutively lost AUs.

`MAX_AU_SIZE` – Maximum size of an AU in bytes.

`AVG_AU_SIZE` – Average size of an AU in bytes.

`MAX_AU_RATE` – Maximum arrival rate of AUs in AUs/second.

8.6.16 ExtensionDescriptor

8.6.16.1 Syntax

```

abstract class ExtensionDescriptor extends BaseDescriptor
: bit(8) tag = ExtDescrTagStartRange .. ExtDescrTagEndRange {
    // empty. To be filled by classes extending this class.
}

```

8.6.16.2 Semantics

This class is an abstract base class that may be extended for defining additional descriptors in future. The available range of class tag values allow ISO defined extensions as well as private extensions. A descriptor that allows to aggregate `ExtensionDescriptor` classes may actually aggregate any of the classes that extend `ExtensionDescriptor`. Extension descriptors may be ignored by a terminal that conforms to ISO/IEC 14496-1.

8.6.17 RegistrationDescriptor

The registration descriptor provides a method to uniquely and unambiguously identify formats of private data streams.

8.6.17.1 Syntax

```

class RegistrationDescriptor extends BaseDescriptor : bit(8) tag=RegistrationDescrTag {
    bit(32) formatIdentifier;
    bit(8) additionalIdentificationInfo[sizeOfInstance-4];
}

```

8.6.17.2 Semantics

`formatIdentifier` – is a value obtained from a Registration Authority as designated by ISO.

`additionalIdentificationInfo` – The meaning of `additionalIdentificationInfo`, if any, is defined by the assignee of that `formatIdentifier`, and once defined, shall not change.

The registration descriptor is provided in order to enable users of ISO/IEC 14496-1 to unambiguously carry elementary streams with data whose format is not recognized by ISO/IEC 14496-1. This provision will permit

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ISO/IEC 14496-1 to carry all types of data streams while providing for a method of unambiguous identification of the characteristics of the underlying private data streams.

In the following subclause and Annex D, the benefits and responsibilities of all parties to the registration of private data format are outlined.

8.6.17.2.1 Implementation of a Registration Authority (RA)

ISO/IEC JTC 1/SC 29 shall issue a call for nominations from Member Bodies of ISO or National Committees of IEC in order to identify suitable organizations that will serve as the Registration Authority for the formatIdentifier as defined in this subclause. The selected organization shall serve as the Registration Authority. The so-named Registration Authority shall execute its duties in compliance with Annex H of the JTC 1 Directives. The registered private data formatIdentifier is hereafter referred to as the Registered Identifier (RID).

Upon selection of the Registration Authority, JTC 1 shall require the creation of a Registration Management Group (RMG) which will review appeals filed by organizations whose request for an RID to be used in conjunction with ISO/IEC 14496-1 has been denied by the Registration Authority.

Annex D provides information on the procedure for registering a unique format identifier.

8.6.18 Object Content Information Descriptors

8.6.18.1 Overview

This subclause defines the descriptors that constitute the object content information. These descriptors may either be included in an OCI_Event in an OCI stream or be part of an object descriptor or ES_Descriptor as defined in 8.6.

8.6.18.2 OCI_Descriptor Class

8.6.18.2.1 Syntax

```
abstract class OCI_Descriptor extends BaseDescriptor
  : bit(8) tag= OCIDescrTagStartRange .. OCIDescrTagEndRange
{
  // empty. To be filled by classes extending this class.
}
```

8.6.18.2.2 Semantics

This class is an abstract base class that is extended by the classes specified in the subsequent clauses. A descriptor or an OCI_Event that allows to aggregate classes of type OCI_Descriptor may actually aggregate any of the classes that extend OCI_Descriptor.

8.6.18.3 Content classification descriptor

8.6.18.3.1 Syntax

```
class ContentClassificationDescriptor extends OCI_Descriptor
  : bit(8) tag= ContentClassificationDescrTag {
  bit(32) classificationEntity;
  bit(16) classificationTable;
  bit(8) contentClassificationData[sizeOfInstance-6];
}
```

8.6.18.3.2 Semantics

The content classification descriptor provides one or more classifications of the event information. The classificationEntity field indicates the organization that classifies the content. The possible values have to be registered with a registration authority to be identified.

classificationEntity – indicates the content classification entity. The values of this field are to be defined by a registration authority to be identified.

`classificationTable` – indicates which classification table is being used for the corresponding classification. The classification is defined by the corresponding classification entity. 0x00 is a reserved value.

`contentClassificationData[]` – this array contains a classification data set using a non-default classification table.

8.6.18.4 Key Word Descriptor

8.6.18.4.1 Syntax

```
class KeyWordDescriptor extends OCI_Descriptor : bit(8) tag=KeyWordDescrTag {
    int i;
    bit(24) languageCode;
    bit(1) isUTF8_string;
    aligned(8) unsigned int(8) keyWordCount;
    for (i=0; i<keyWordCount; i++) {
        unsigned int(8) keyWordLength[[i]];
        if (isUTF8_string) then {
            bit(8) keyWord[[i]][keyWordLength[i]];
        } else {
            bit(16) keyWord[[i]][keyWordLength[i]];
        }
    }
}
```

8.6.18.4.2 Semantics

The key word descriptor allows the OCI creator/provider to indicate a set of key words that characterize the content. The choice of the key words is completely free but each time the key word descriptor appears, all the key words given are for the language indicated in `languageCode`. This means that, for a certain event, the key word descriptor must appear as many times as the number of languages for which key words are to be provided.

`languageCode` – contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields.

`isUTF8_string` – indicates that the subsequent string is encoded with one byte per character (UTF-8). Else it is two byte per character.

`keyWordCount` – indicates the number of key words to be provided.

`keyWordLength` – specifies the length in characters of each key word.

`keyWord[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the key word.

8.6.18.5 Rating Descriptor

8.6.18.5.1 Syntax

```
class RatingDescriptor extends OCI_Descriptor : bit(8) tag=RatingDescrTag {
    bit(32) ratingEntity;
    bit(16) ratingCriteria;
    bit(8) ratingInfo[sizeOfInstance-6];
}
```

8.6.18.5.2 Semantics

This descriptor gives one or more ratings, originating from corresponding rating entities, valid for a specified country. The `ratingEntity` field indicates the organization which is rating the content. The possible values have to be registered with a registration authority to be identified. This registration authority shall make the semantics of the rating descriptor publicly available.

`ratingEntity` – indicates the rating entity. The values of this field are to be defined by a registration authority to be identified.

`ratingCriteria` – indicates which rating criteria are being used for the corresponding rating entity. The value 0x00 is reserved.

`ratingInfo[]` – this array contains the rating information.

8.6.18.6 Language Descriptor

8.6.18.6.1 Syntax

```
class LanguageDescriptor extends OCI_Descriptor : bit(8) tag=LanguageDescrTag {  
    bit(24) languageCode;  
}
```

8.6.18.6.2 Semantics

This descriptor identifies the language of the corresponding audio/speech or text object that is being described.

`languageCode` – contains the ISO 639-2:1998 bibliographic three character language code of the corresponding audio/speech or text object that is being described.

8.6.18.7 Short Textual Descriptor

8.6.18.7.1 Syntax

```
class ShortTextualDescriptor extends OCI_Descriptor : bit(8) tag=ShortTextualDescrTag {  
    bit(24) languageCode;  
    bit(1) isUTF8_string;  
    aligned(8) unsigned int(8) nameLength;  
    if (isUTF8_string) then {  
        bit(8) eventName[nameLength];  
        unsigned int(8) textLength;  
        bit(8) eventText[textLength];  
    } else {  
        bit(16) eventName[nameLength];  
        unsigned int(8) textLength;  
        bit(16) eventText[textLength];  
    }  
}
```

8.6.18.7.2 Semantics

The short textual descriptor provides the name of the event and a short description of the event in text form.

`languageCode` – contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields.

`isUTF8_string` – indicates that the subsequent string is encoded with one byte per character (UTF-8). Else it is two byte per character.

`nameLength` – specifies the length in characters of the event name.

`eventName[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the event name.

`textLength` – specifies the length in characters of the following text describing the event.

`eventText[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the text description for the event.

8.6.18.8 Expanded Textual Descriptor

8.6.18.8.1 Syntax

```
class ExpandedTextualDescriptor extends OCI_Descriptor : bit(8) tag=ExpandedTextualDescrTag {  
    int i;  
    bit(24) languageCode;  
    bit(1) isUTF8_string;
```

```

aligned(8) unsigned int(8) itemCount;
for (i=0; i<itemCount; i++) {
    unsigned int(8) itemDescriptionLength[[i]];
    if (isUTF8_string) then {
        bit(8) itemDescription[[i]][itemDescriptionLength[i]];
    } else {
        bit(16) itemDescription[[i]][itemDescriptionLength[i]];
    }
    unsigned int(8) itemLength[[i]];
    if (isUTF8_string) then {
        bit(8) itemText[[i]][itemLength[i]];
    } else {
        bit(16) itemText[[i]][itemLength[i]];
    }
}
unsigned int(8) textLength;
int nonItemTextLength=0;
while( textLength == 255 ) {
    nonItemTextLength += textLength;
    bit(8) textLength;
}
nonItemTextLength += textLength;
if (isUTF8_string) then {
    bit(8) nonItemText[nonItemTextLength];
} else {
    bit(16) nonItemText[nonItemTextLength];
}
}

```

8.6.18.8.2 Semantics

The expanded textual descriptor provides a detailed description of an event, which may be used in addition to, or independently from, the short event descriptor. In addition to direct text, structured information in terms of pairs of description and text may be provided. An example application for this structure is to give a cast list, where for example the item description field might be “Producer” and the item field would give the name of the producer.

`languageCode` - contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields.

`isUTF8_string` – indicates that the subsequent string is encoded with one byte per character (UTF-8). Else it is two byte per character.

`itemCount` – specifies the number of items to follow (itemised text).

`itemDescriptionLength` – specifies the length in characters of the item description.

`itemDescription[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the item description.

`itemLength` – specifies the length in characters of the item text.

`itemText[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the item text.

`textLength` – specifies the length in characters of the non itemised expanded text. The value 255 is used as an escape code, and it is followed by another `textLength` field that contains the length in bytes above 255. For lengths greater than 511 a third field is used, and so on.

`nonItemText[]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the non itemised expanded text.

8.6.18.9 Content Creator Name Descriptor

8.6.18.9.1 Syntax

```

class ContentCreatorNameDescriptor extends OCI_Descriptor
    : bit(8) tag= ContentCreatorNameDescrTag {
    int i;
    unsigned int(8) contentCreatorCount;

```

```

for (i=0; i<contentCreatorCount; i++){
    bit(24) languageCode[[i]];
    bit(1) isUTF8_string[[i]];
    aligned(8) unsigned int(8) contentCreatorLength[[i]];
    if (isUTF8_string[[i]]) then {
        bit(8) contentCreatorName[[i]][contentCreatorLength[i]];
    } else {
        bit(16) contentCreatorName[[i]][contentCreatorLength[i]];
    }
}
}

```

8.6.18.9.2 Semantics

The content creator name descriptor indicates the name(s) of the content creator(s). Each content creator name may be in a different language.

`contentCreatorCount` – indicates the number of content creator names to be provided.

`languageCode` – contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields. Note that for languages that only use Latin characters, just one byte per character is needed in Unicode (ISO/IEC 10646-1).

`isUTF8_string` – indicates that the subsequent string is encoded with one byte per character (UTF-8). Else it is two byte per character.

`contentCreatorLength[[i]]` – specifies the length in characters of each content creator name.

`contentCreatorName[[i]][]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the content creator name.

8.6.18.10 Content Creation Date Descriptor

8.6.18.10.1 Syntax

```

class ContentCreationDateDescriptor extends OCI_Descriptor
    : bit(8) tag=ContentCreationDateDescrTag {
    bit(40) contentCreationDate;
}

```

8.6.18.10.2 Semantics

This descriptor identifies the date of the content creation.

`contentCreationDate` – contains the content creation date of the data corresponding to the event in question, in Universal Time, Co-ordinated (UTC) and Modified Julian Date (MJD) (see Annex F). This field is coded as 16 bits giving the 16 least significant bits of MJD followed by 24 bits coded as 6 digits in 4-bit Binary Coded Decimal (BCD). If the content creation date is undefined all bits of the field are set to 1.

8.6.18.11 OCI Creator Name Descriptor

8.6.18.11.1 Syntax

```

class OCICreatorNameDescriptor extends OCI_Descriptor
    : bit(8) tag=OCICreatorNameDescrTag {
    int i;
    unsigned int(8) OCICreatorCount;
    for (i=0; i<OCICreatorCount; i++) {
        bit(24) languageCode[[i]];
        bit(1) isUTF8_string;
        aligned(8) unsigned int(8) OCICreatorLength[[i]];
        if (isUTF8_string) then {
            bit(8) OCICreatorName[[i]][OCICreatorLength];
        } else {
            bit(16) OCICreatorName[[i]][OCICreatorLength];
        }
    }
}

```

```

    }
}
```

8.6.18.11.2 Semantics

The name of OCI creators descriptor indicates the name(s) of the OCI description creator(s). Each OCI creator name may be in a different language.

`OCICreatorCount` – indicates the number of OCI creators.

`languageCode[[i]]` – contains the ISO 639-2:1998 bibliographic three character language code of the language of the following text fields.

`isUTF8_string` – indicates that the subsequent string is encoded with one byte per character (UTF-8). Else it is two byte per character.

`OCICreatorLength[[i]]` – specifies the length in characters of each OCI creator name.

`OCICreatorName[[i]]` – a Unicode (ISO/IEC 10646-1) encoded string that specifies the OCI creator name.

8.6.18.12 OCI Creation Date Descriptor

8.6.18.12.1 Syntax

```

class OCICreationDateDescriptor extends OCI_Descriptor
    : bit(8) tag=OCICreationDateDescrTag {
    bit(40) OCICreationDate;
}
```

8.6.18.12.2 Semantics

This descriptor identifies the creation date of the OCI description.

`OCICreationDate` - This 40-bit field contains the OCI creation date for the OCI data corresponding to the event in question, in Co-ordinated Universal Time (UTC) and Modified Julian Date (MJD) (see Annex F). This field is coded as 16 bits giving the 16 least significant bits of MJD followed by 24 bits coded as 6 digits in 4-bit Binary Coded Decimal (BCD). If the OCI creation date is undefined all bits of the field are set to 1.

8.6.18.13 SMPTE Camera Position Descriptor

8.6.18.13.1 Syntax

```

class SmpteCameraPositionDescriptor extends OCI_Descriptor : bit (8)
tag=SmpteCameraPositionDescrTag {
    unsigned int (8) cameraID;
    unsigned int (8) parameterCount;
    for (i=0; i<parameterCount; i++) {
        bit (8) parameterID;
        bit (32) parameter;
    }
}
```

8.6.18.13.2 Semantics

The SMPTE metadata descriptor provides metadata defined by the Proposed SMPTE Standard 315M of “camera positioning information conveyed by ancillary data packets.” The SMPTE 315M defines IDs and data formats for the following parameters:

- camera relative position
- camera pan
- camera tilt
- camera roll

- origin of world coordinate longitude
- origin of world coordinate latitude
- origin of world coordinate altitude
- vertical angle of view
- focus distance
- lens opening (iris or F-value)
- time address information
- object relative position

cameraID - contains the b(0-7) of C-ID of the UDW in Figure 6.

parameterCount - specifies the number of parameters and is equal to (the Data Count Word (DC) – 18) / 5.

parameterID - contains the b(0-7) of i-th IDn of the UDW.

parameter - contains the i-th Parameter n of the UDW (b(0-7) of each word).

8.6.18.13.3 Packet structure defined by SMPTE 315M

Ancillary data packet and space format is defined by ANSI/SMPTE 291M. The SMPTE 315M is one of the registered formats for a specific application of user data space defined by the 291M. The structure of binary-type camera positioning data packets described in the SMPTE 315M is illustrated in Figure 6.

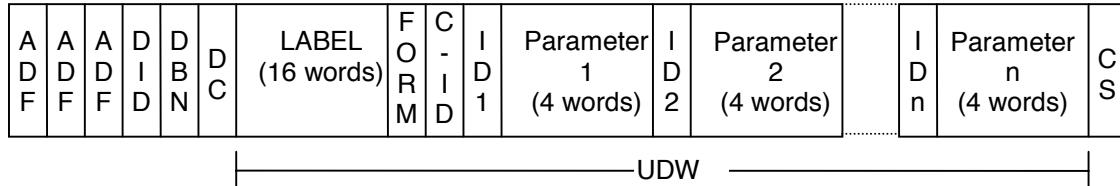


Figure 6 - Binary-type camera positioning data packets (SMPTE 315M)

Ancillary data is defined as 10-bit words. B(0-7), b8 and b9 represent actual data, even parity for b(0-7) and not b8 respectively except ADF.

| | |
|--------|---|
| ADF: | Ancillary Data Flag (000 h, 3ff h, 3ff h) |
| DID: | Data Identification Word (2f0 h) |
| DBN: | Data Block Number Word |
| DC: | Data Count Word |
| UDW: | User Data Words (up to 255 words) |
| LABEL: | SMPTE label for metadata of class “camera positioning information” (16 words) |
| FORM: | Data Type Identification Flag Word (1 word) |
| C-ID: | Camera Identification Word (1 word) |
| IDn: | Parameter Identification Word (1 word for each parameter) |

Parameter n: Parameter Data Words (4 words for each parameter)

CS: Checksum Word

The 4 words LABEL(8-11) of LABEL(0-15) shall be set to ‘C’, ‘A’, ‘P’, ‘O’. The Data Type Identification Flag Word (FORM) indicates the data type of the camera identification word (C-ID), parameter identification word (IDn) and parameter data word (Parameter n) contained in the packet. In case of binary-type camera positioning data FORM(0-1) shall be set to 0 h.

8.6.19 Extension Profile Level Descriptor

8.6.19.1 Syntax

```
class ExtensionProfileLevelDescriptor() extends BaseDescriptor : bit(8)
ExtensionProfileLevelDescrTag {
    bit(8) profileLevelIndicationIndex;
    bit(8) ODPProfileLevelIndication;
    bit(8) sceneProfileLevelIndication;
    bit(8) audioProfileLevelIndication;
    bit(8) visualProfileLevelIndication;
    bit(8) graphicsProfileLevelIndication;
    bit(8) MPEGJProfileLevelIndication;
}
```

8.6.19.2 Semantics

The `ExtensionProfileLevelDescriptor` conveys profile and level extension information. This descriptor is used to signal a profile and level indication set and its unique index and can be extended by ISO to signal any future set of profiles and levels.

`profileLevelIndicationIndex` – a unique identifier for the set of profile and level indications described in this descriptor within the name scope defined by the IOD.

`ODProfileLevelIndication` – an indication of the profile and level required to process object descriptor streams associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

`sceneProfileLevelIndication` – an indication of the profile and level required to process the scene graph nodes within scene description streams associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

`audioProfileLevelIndication` – an indication of the profile and level required to process audio streams associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

`visualProfileLevelIndication` – an indication of the profile and level required to process visual streams associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

`graphicsProfileLevelIndication` – an indication of the profile and level required to process graphics nodes within scene description streams associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

`MPEGJProfileLevelIndication` – an indication as defined in Table 13 of the MPEG-J profile and level required to process the content associated with the `InitialObjectDescriptor` containing this Extension Profile and Level descriptor.

Table 13 - MPEGJProfileLevelIndication Values

| Value | Profile | Level |
|--------------|-------------------------------|--------------|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Personal profile | L1 |
| 0x02 | Main profile | L1 |
| 0x03-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no MPEG-J profile specified | - |
| 0xFF | no MPEG-J capability required | - |

Note: Usage of the value 0xFE may indicate that the content described by this InitialObjectDescriptor does not comply to any conformance point specified in ISO/IEC 14496-1

8.6.20 Profile Level Indication Index Descriptor

8.6.20.1 Syntax

```
class ProfileLevelIndicationIndexDescriptor () extends BaseDescriptor
: bit(8) ProfileLevelIndicationIndexDescrTag {
    bit(8) profileLevelIndicationIndex;
}
```

8.6.20.2 Semantics

profileLevelIndicationIndex – a unique identifier for the set of profile and level indications described in this descriptor within the name scope defined by the IOD.

8.7 Rules for Usage of the Object Description Framework

8.7.1 Aggregation of Elementary Stream Descriptors in a Single Object Descriptor

8.7.1.1 Overview

An object descriptor shall aggregate the descriptors for the set of elementary streams that is intended to be associated to a single node of the scene description and that usually relate to a single audio-visual object. The set of streams may convey a scaleable content representation as well as multiple alternative content representations, e.g., multiple qualities or different languages. Additional streams with IPMP and object content information may be attached.

These options are described by the ES_Descriptor syntax elements streamDependenceFlag, dependsOn_ES_ID, as well as streamType. The semantic rules for the aggregation of elementary stream descriptors within one object descriptor (OD) are specified in this subclause.

8.7.1.2 Aggregation of Elementary Streams with the same streamType

An OD may aggregate multiple ES_Descriptors with the same streamType of either visualStream, audioStream or SceneDescriptionStream. However, descriptors for streams with two of these types shall not be mixed within one OD.

8.7.1.3 Aggregation of Elementary Streams with Different streamTypes

In the following cases ESs with different streamType may be aggregated:

- An OD may aggregate zero or one additional ES_Descriptor with streamType = ObjectContentInfoStream (see 8.4.2). This ObjectContentInfoStream shall be valid for the content conveyed through the other visual, audio or scene description streams whose descriptors are aggregated in this OD.
- An OD may aggregate zero or one additional ES_Descriptors with streamType = ClockReferenceStream (see 10.2.5). This ClockReferenceStream shall be valid for the ES within the name scope that refer to the ES_ID of this ClockReferenceStream in their SLConfigDescriptor.

- An OD may aggregate zero or more additional ES_Descriptors with streamType = IPMPStream (see 8.3.2). This IPMPStream shall be valid for the content conveyed through the other visual, audio or scene description streams whose descriptors are aggregated in this OD.

8.7.1.4 Aggregation of scene description streams and object descriptor streams

An object descriptor that aggregates one or more ES_Descriptors of streamType = SceneDescriptionStream may aggregate any number of additional ES_Descriptors with streamType = ObjectDescriptorStream. ES_Descriptors of streamType = ObjectDescriptorStream shall not be aggregated in object descriptors that do not contain ES_Descriptors of streamType = SceneDescriptionStream.

This means that scene description and object descriptor streams are always combined within one object descriptor. The dependencies between these streams are defined in 8.7.1.5.2.

8.7.1.5 Elementary Stream Dependencies

8.7.1.5.1 Independent elementary streams

ES_Descriptors within one OD with the same streamType of either audioStream, visualStream or SceneDescriptionStream that have streamDependenceFlag=0 refer to independent elementary streams. Such independent elementary streams shall convey alternative representations of the same content. Only one of these representations shall be selected for use in the scene.

NOTE — Independent ESs should be ordered within an OD according to the content creator's preference. The ES that is first in the list of ES aggregated to one object descriptor should be preferable over an ES that follows later. In case of audio streams, however, the selection should for obvious reasons be done according to the preferred language of the receiving terminal.

8.7.1.5.2 Dependent elementary streams

ES_Descriptors within one OD with the same streamType of either audioStream, visualStream, SceneDescriptionStream or ObjectDescriptorStream that have streamDependenceFlag=1 refer to dependent elementary streams. The ES_ID of the stream on which the dependent elementary stream depends is indicated by dependsOn_ES_ID. The ES Descriptor with this ES_ID shall be aggregated to the same OD. One independent elementary stream per object descriptor and all its dependent elementary streams may be selected for concurrent use in the scene.

Stream dependencies are governed by the following rules:

- For dependent ES of streamType equal to either audioStream or visualStream the dependent ES shall have the same streamType as the ES on which it depends. This implies that the dependent stream contains enhancement information to the one it depends on. The precise semantic meaning of the dependencies is opaque at this layer.
- An ES with a streamType of SceneDescriptionStream shall only depend on an ES with streamType of SceneDescriptionStream or ObjectDescriptorStream.

Dependency on an ObjectDescriptorStream implies that the ObjectDescriptorStream contains the object descriptors that are referred to by this SceneDescriptionStream.

Dependency on a SceneDescriptionStream implies that the dependent stream contains enhancement information to the one it depends on. The dependent SceneDescriptionStream shall depend on the same ObjectDescriptorStream on which the other SceneDescriptionStream depends.

- An ES with a streamType of ObjectDescriptorStream shall only depend on an ES with a streamType of SceneDescriptionStream. This dependency does not have implications for the object descriptor stream.

Only if a second stream with streamType of SceneDescriptionStream depends on this stream with streamType = ObjectDescriptorStream, it implies that the second SceneDescriptionStream depends on the first SceneDescriptionStream. The object descriptors in the ObjectDescriptorStream shall only be valid for the second SceneDescriptionStream.

- An ES that flows upstream, as indicated by `DecoderConfigDescriptor.upStream = 1` shall always depend upon another ES that has the `upStream` flag set to zero. This implies that this upstream is associated to the downstream it depends on. If the downstream is an `ObjectDescriptorStream` or `SceneDescriptionStream`, the upstream shall be associated to all downstreams specified in that `ObjectDescriptorStream` or `SceneDescriptionStream`.
- The availability of the dependent stream is undefined if an `ES_Descriptor` for the stream it depends upon is not available.

8.7.2 Linking Scene Description and Object Descriptors

8.7.2.1 Associating Object Descriptors to BIFS Nodes

Some BIFS nodes contain an `url` field. Such nodes are associated to their elementary stream resources (if any) via an object descriptor. The association is established by means of the `objectDescriptorID`, as specified in 9.3.7.20.2. The name scope for this ID is specified in 8.7.2.4.

Each BIFS node requires a specific `streamType` (audio, visual, inlined scene description, etc.) for its associated elementary streams. The associated object descriptor shall contain `ES_Descriptors` with this `streamType`. The behavior of the terminal is undefined if an object descriptor contains `ES_Descriptors` with stream types that are incompatible with the associated BIFS node.

Note that commands adding or removing object descriptors need not be co-incident in time with the addition or removal of BIFS nodes in the scene description that refer to such an object descriptor. However, the behavior of the terminal is undefined if a BIFS node in the scene description references an object descriptor that is no longer valid.

The terminal shall gracefully handle references from the scene description to object descriptors that are not currently available.

8.7.2.2 Multiple scene description and object description streams

An object descriptor that is associated to an **Inline** node of the scene description or that represents the primary access to content compliant with the ISO/IEC 14496 specifications (initial object descriptor) aggregates as a minimum, one scene description stream and the corresponding object descriptor stream (if additional elementary streams need to be referenced).

However, it is permissible to split both the scene description and the object descriptors in multiple streams. This allows a bandwidth-scaleable encoding of the scene description. Each stream shall contain a valid sequence of access units as defined in 9.2.1.3 and 8.5.2, respectively. All resulting scene description streams and object descriptor streams shall remain aggregated in a single object descriptor. The dependency mechanism shall be used to indicate how the streams depend on each other.

All streams shall continue to be processed by a single scene description and object descriptor decoding process, respectively. The time stamps of the access units in different streams shall be used to re-establish the original order of access units.

NOTE — This form of partitioning of the scene description and the object descriptor streams in multiple streams is not visible in the scene description itself.

8.7.2.3 Scene and Object Description in Case of Inline Nodes

The BIFS scene description allows to recursively partition a scene through the use of **Inline** nodes (see 9.4.2.62). Each **Inline** node is associated to an object descriptor that points to at least one additional scene description stream as well as another object descriptor stream (if additional elementary streams need to be referenced). An example for such a hierarchical scene description can be found in 8.7.3.8.2.

8.7.2.4 Name Scope of Identifiers

The scope of the `objectDescriptorID`, `ES_ID` and `IPMP_DescriptorID` identifiers that label the object descriptors, elementary stream descriptors and IPMP descriptors, respectively, is defined as follows. This definition

is based on the restriction that associated scene description and object descriptor streams shall always be aggregated in a single object descriptor, as specified in 8.7.1.4. The following rule defines the name scope:

- Two `objectDescriptorID`, `ES_ID` or `IPMP_DescriptorID` as well as `nodeID` and `ROUTEID` identifiers belong to the same name scope if and only if these identifiers occur in elementary streams with a `streamType` of either `ObjectDescriptorStream` or `SceneDescriptionStream` that are aggregated in a single initial object descriptor or a single object descriptor associated to an **Inline** node.

NOTE 1 — Hence, the difference between the two methods specified in 8.7.2.2 and 8.7.2.3 above to partition a scene description in multiple streams is that the first method allows multiple scene description streams that refer to the same name scope while an **Inline** node opens a new name scope.

NOTE 2 — This implies that a URL in an object descriptor opens a new name scope since it points to an object descriptor that is not carried in the same `ObjectDescriptorStream`.

NOTE 3 — It is recommendable to extend the name scope for the stream related identifiers, namely, `ES_ID` and `IPMP_DescriptorID`, to the underlying communication session that is established as described in 8.7.3.6. This implies that those identifiers will be unique within such a communication session.

8.7.2.5 Reuse of identifiers

Within a single name scope an `ES_ID` identifier shall always refer to a single instance of an elementary stream.

Note: If two `ES_Descriptors` within two object descriptors reference a given `ES_ID`, this means that the second reference may not receive the stream content from the beginning if the first reference has already started the stream.

For reasons of error resilience, it is recommended not to reuse `objectDescriptorID` and `ES_ID` identifiers to identify more than one object or elementary stream, respectively, within one presentation. That means, if an object descriptor or elementary stream descriptor is removed by means of an OD command and later on reinstalled with another OD command, then it shall still point to the same content item as before.

8.7.3 ISO/IEC 14496 Content Access

8.7.3.1 Introduction

In order to access ISO/IEC 14496 compliant content it is a pre-condition that an initial object descriptor to such content is known through means outside the scope of ISO/IEC 14496. The subsequent content access procedure is specified conceptually, using a number of walk throughs. Its precise definition depends on the chosen delivery layer.

For applications that implement the DMIF Application Interface (DAI) specified in ISO/IEC 14496-6 which abstracts the delivery layer, a mapping of the conceptual content access procedure to calls of the DAI is specified in 8.7.3.9.

The content access procedure determines the set of required elementary streams, requests their delivery and associates them to the scene description. The selection of a subset of elementary streams suitable for a specific ISO/IEC 14496 terminal is possible, either based on profiles or on inspection of the set of object descriptors.

8.7.3.2 The Initial Object Descriptor

Initial object descriptors convey information about the profiles required by the terminal compliant with ISO/IEC 14496 specifications to be able to process the described content. This profile information summarizes the complexity of the content referenced directly or indirectly through this initial object descriptor, i.e., it indicates the overall terminal capabilities required to decode and present this content. Therefore initial object descriptors constitute self-contained access points to content compliant with ISO/IEC 14496 specifications.

There are two constraints to this general statement:

- If the `includeInlineProfileLevelFlag` of the initial object descriptor is not set, the complexity of any inlined content is not included in the profile indications.
- In addition to the elementary streams that are decodable by the terminal conforming to the indicated profiles, alternate content representations might be available. This is further explained in 8.7.3.4.

An initial object descriptor may be conveyed by means not defined in ISO/IEC 14496. The content may be accessed starting from the elementary streams that are described by this initial object descriptor, usually one or more scene description streams and zero or more object descriptor streams.

Content referred to by an initial object descriptor may itself be referenced from another piece of ISO/IEC 14496 content. In this case, the initial object descriptor will be conveyed in an object descriptor stream and the OD_IDs of both initial object descriptors and ordinary object descriptors belong to the same name scope.

Ordinary object descriptors may be used as well to describe scene description and object descriptor streams. However, since they do not carry profile information, they can only be used to access content if that information is either not required by the terminal or is obtained by other means.

8.7.3.3 Usage of URLs in the Object Descriptor Framework

URLs in the object description framework serve to locate either inlined ISO/IEC 14496 content or the elementary stream data associated to individual audio-visual objects.

URLs in ES_Descriptors locate elementary stream data that shall be delivered as SL-packetized stream by the delivery entity associated to the current name scope. The complete description of the stream (its ES_Descriptor) is available locally.

URLs in object descriptors locate an object descriptor at a remote location. Only the content of this object descriptor shall be returned by the delivery entity upon access to this URL. This implies that the description of the resources for the associated BIFS node or the inlined content is only available at the remote location. Note, however, that depending on the value of `includeInlineProfileLevelFlag` in the initial object descriptor, the global resources needed may already be known (i.e., including remote, inlined portions).

8.7.3.4 Selection of Elementary Streams for an Audio-Visual Object

Elementary streams are attached through their object descriptor to appropriate BIFS nodes which, in most cases, constitute the representation of a single audio-visual object in the scene. The selection of one or more ESs for each BIFS node may be governed by the profile indications that are conveyed in the initial object descriptor. All object descriptors shall at least include one elementary stream with suitable object type to satisfy the initially signaled profiles.

Additionally, object descriptors may aggregate ES_Descriptors for elementary streams that require more computing or bandwidth resources. Those elementary streams may be used by the receiving terminal if it is capable of processing them.

In case initial object descriptors do not indicate any profile and level or if profile and level indications are disregarded, an alternative to the profile driven selection of streams exists. The receiving terminal may evaluate the ES_Descriptors of all available elementary streams for each BIFS node and choose by some non-standardized way for which subset it has sufficient resources to decode them while observing the constraints specified in this subclause.

NOTE — Some restrictions on the selection of and access to elementary streams might exist if a set of elementary streams shares a single object time base (see 10.2.6).

8.7.3.5 Content access in “push” and “pull” scenarios

In an interactive, or “pull” scenario, the receiving terminal actively requests the establishment of sessions and the delivery of content, i.e., streams. This usually involves a session and channel set up protocol between sender and receiver. This protocol is not specified here. However, the conceptual steps to be performed are the same in all cases and are specified in the subsequent clauses.

In a broadcast, or “push” scenario, the receiving terminal passively processes what it receives. Instead of issuing requests for session or channel set up the receiving terminal shall evaluate the relevant descriptive information that associates ES_IDs to their transport channel. The syntax and semantics of this information is outside the scope of ISO/IEC 14496, however, it needs to be present in any delivery layer implementation. This allows the terminal to gain access to the elementary streams forming part of the content.

8.7.3.6 Content access through a known Object Descriptor

8.7.3.6.1 Pre-conditions

- An object descriptor has been acquired. This may be an initial object descriptor.
- The object descriptor contains ES_Descriptors pointing to object descriptor stream(s) and scene description stream(s) using ES_IDs.
- A communication session to the source of these streams is established.
- A mechanism exists to open a channel that takes user data as input and provides some returned data as output.

8.7.3.6.2 Content Access Procedure

The content access procedure shall be equivalent to the following:

1. The object descriptor is evaluated and the ES_ID for the streams that are to be opened are determined.
2. Requests for opening the selected ESs are made, using a suitable channel set up mechanism with the ES_IDs as parameter.
3. The channel set up mechanism shall return handles to the streams that correspond to the requested list of ESs.
4. Requests for delivery of the selected ESs are made.
5. Interactive scenarios: Delivery of streams starts. All scenarios: The streams now become accessible.
6. Scene description and object descriptor stream are evaluated.
7. Further streams are opened as needed with the same procedure, starting at step 1.

8.7.3.7 Content access through a URL in an Object Descriptor

8.7.3.7.1 Pre-conditions

- A URL to an object descriptor or an initial object descriptor has been acquired.
- A mechanism exists to open a communication session that takes a URL as input and provides some returned data as output.

8.7.3.7.2 Content access procedure

The content access procedure shall be equivalent to the following:

1. A connection to the source of the URL is made, using a suitable service set up call.
2. The service set up call shall return data consisting of a single object descriptor.
3. Continue at step 1 in 8.7.3.6.2.

8.7.3.8 Content access through a URL in an elementary stream descriptor

8.7.3.8.1 Pre-conditions

- An ES_Descriptor pointing to a stream through a URL has been acquired. (Note that the ES_Descriptor fully specifies the configuration of the stream.)
- A mechanism exists to open a communication session that takes a URL as input and provides some returned data as output.

- A mechanism exists to open a channel that takes user data as input and provides some returned data as output.

8.7.3.8.2 Content access procedure

The content access procedure shall be equivalent to the following:

1. A request to open the communication session is made, using a suitable session set up mechanism with the URL as parameter.
2. The session set up mechanism shall return a handle to the session that corresponds to the requested URL.
3. Request to open the stream is made, using a suitable channel set up mechanism.
4. The channel set up mechanism shall return a handle to the stream that corresponds to the originally requested URL.
5. Requests for delivery of the selected stream are made.
6. Interactive scenarios: Delivery of stream starts. All scenarios: The stream now becomes accessible.

EXAMPLE — Access to Complex Content

The example in Figure 7 shows a complex piece of ISO/IEC 14496 content, consisting of three parts. The upper part is a scene accessed through its initial object descriptor. It contains, among others a visual and an audio stream. A second part of the scene is inlined and accessed through its initial object descriptor that is pointed to (via URL) in the object descriptor stream of the first scene. Utilization of the initial object descriptor allows the signaling of profile information for the second scene. Therefore this scene may also be used without the first scene. The second scene contains, among others, a scaleably encoded visual object and an audio object. A third scene is inlined and accessed via the ES_IDs of its object descriptor and scene description streams. These ES_IDs are known from an object descriptor conveyed in the object descriptor stream of the second scene. Note that this third scene is not accessed through an initial object descriptor. Therefore the profile information for this scene need to be included in the profile information for the second scene.

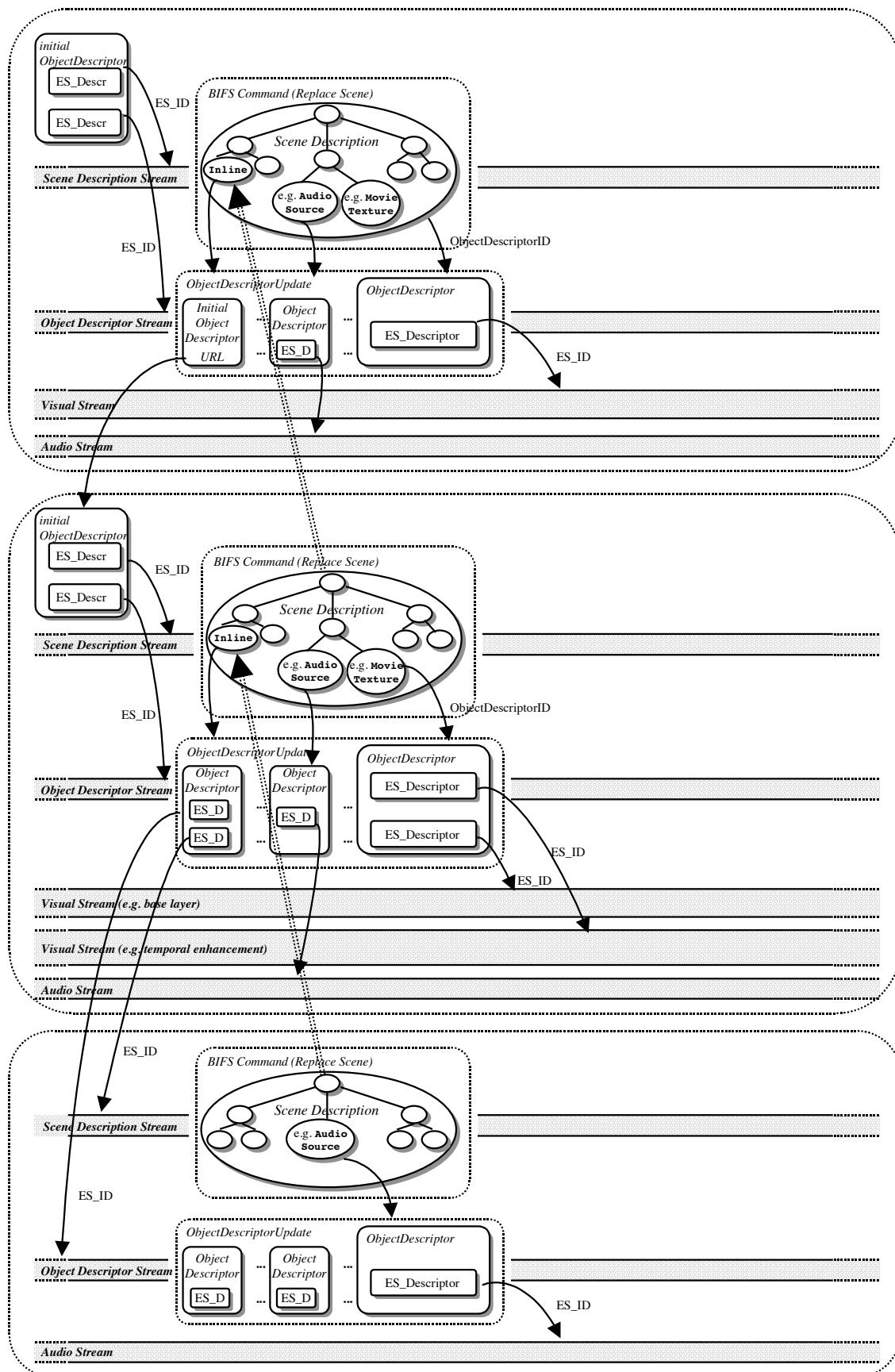


Figure 7 - Complex content example

8.7.3.9 Mapping of Content Access Procedure to DAI calls

The following two DAI primitives, quoted from ISO/IEC 14496-6, subclause 10.4, are required to implement the content access procedure described in 8.7.3.6 to 8.7.3.8:

DA_ServiceAttach (IN: URL, uuDataInBuffer, uuDataInLen;
 OUT: response, serviceSessionId, uuDataOutBuffer, uuDataOutLen)

DA_ChannelAdd (IN: serviceSessionId, loop(qosDescriptor, direction, uuDataInBuffer, uuDataInLen);
 OUT: loop(response, channelHandle, uuDataOutBuffer, uuDataOutLen))

DA_ServiceAttach is used to implement steps 1 and 2 of 8.7.3.7.2. The URL shall be passed to the IN: URL parameter. UuDataInBuffer shall remain empty. The returned serviceSessionId shall be kept for future reference to this URL. UuDataOutBuffer shall contain a single object descriptor.

DA_ChannelAdd is used to implement steps 2 and 3 of 8.7.3.6.2. serviceSessionId shall be the identifier for the service session that has supplied the object descriptor that includes the ES_Descriptor that is currently processed. QosDescriptor shall be the QoS_Descriptor of this ES_Descriptor, direction shall indicate upstream or downstream channels according to the DecoderConfigDescriptor.upstream flag. UuDataInBuffer shall contain the ES_ID of this ES_Descriptor. On successful return, channelHandle shall contain a valid, however, not normative handle to the accessible stream.

DA_ChannelAdd is used to implement steps 1 and 2 of 8.7.3.8.2. serviceSessionId shall be the identifier for the service session that has supplied the object descriptor that includes the ES_Descriptor that is currently processed. QosDescriptor shall be the QoS_Descriptor of this ES_Descriptor, direction shall indicate upstream or downstream channels according to the DecoderConfigDescriptor.upstream flag. UuDataInBuffer shall contain the URL of this ES_Descriptor. On successful return, channelHandle shall contain a valid, however, not normative handle to the accessible stream.

NOTE 1 — It is a duty of the service to discriminate between the two cases with either ES_ID or URL as parameters to uuDataInBuffer in DA_ChannelAdd.

NOTE 2 — Step 4 in 8.7.3.6.2 and step 3 in 8.7.3.8.2 are currently not mapped to a DAI call in a normative way. It may be implemented using the DA_UserCommand() primitive.

The set up example in the following figure conveys an initial object descriptor that points to one SceneDescriptionStream, an optional ObjectDescriptorStream and additional optional SceneDescriptionStreams or ObjectDescriptorStreams. The first request to the DAI will be a DA_ServiceAttach() with the content address as a parameter. This call will return an initial object descriptor. The ES_IDs in the contained ES_Descriptors will be used as parameters to a DA_ChannelAdd() that will return handles to the corresponding channels.

Additional streams (if any) that are identified when processing the content of the object descriptor stream(s) are subsequently opened using the same procedure. The object descriptor stream is not required to be present if no further audio- or visual streams or inlined scene description streams form part of the content.

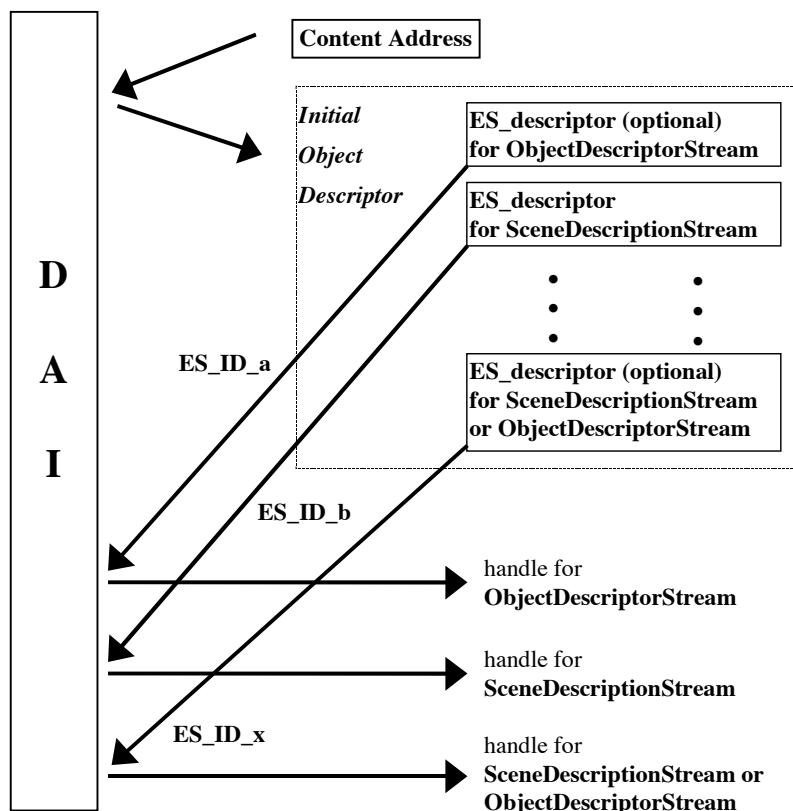


Figure 8 - Requesting stream delivery through the DAI

8.8 Usage of the IPMP System interface

8.8.1 Overview

IPMP elementary streams and descriptors may be used in a variety of ways. For instance, IPMP elementary streams may convey time-variant IPMP information such as keys that change periodically. An IPMP elementary stream may be associated with a given elementary stream or set of elementary streams. Similarly, IPMP descriptors may be used to convey time-invariant or slowly changing IPMP information associated with a given elementary stream or set of elementary streams. This subclause specifies methods how to associate an IPMP system to an elementary stream or a set of elementary streams.

8.8.2 Association of an IPMP System with ISO/IEC 14496 content

8.8.2.1 Association in the initial object descriptor

An IPMP System may be associated with ISO/IEC 14496 content in the initial object descriptor. In that case the initial object descriptor shall aggregate in addition to the ES_Descriptors for scene description and object descriptor streams one or more ES_Descriptors that reference one or more IPMP elementary streams. This implies that all the elementary streams that are described through this initial object descriptor are governed by the one or more IPMP Systems that are identified within the one or more IPMP streams.

8.8.2.2 Association in other object descriptors

An IPMP System may be associated with ISO/IEC 14496 content in an object descriptor in three ways:

In the first case, the object descriptor aggregates in addition to the ES_Descriptors for the content elementary streams one or more ES_Descriptors that reference one or more IPMP elementary streams. This implies that all the content elementary streams described through this object descriptor are governed by the one or more IPMP Systems that are identified within the one or more IPMP streams. Note that an ES_Descriptor that describes an IPMP stream may contain references to IPMP_Descriptors.

The second method is to include one or more IPMP_DescriptorPointers in the object descriptor. This implies that all content elementary streams described by this object descriptor are governed by the IPMP System(s) that is/are identified within the referenced IPMP descriptor(s).

The third method is to include IPMP_DescriptorPointers in the ES_Descriptors embedded in this object descriptor. This implies that the elementary stream referenced by such an ES_Descriptor is controlled by an IPMP System.

8.8.3 IPMP of Object Descriptor streams

Object Descriptor streams shall not be affected by IPMP Systems, i.e., they shall always be available without protection.

An IPMP_Descriptor associated with an object descriptor stream through an IPMP_DescriptorPointer implies that an IPMP System controls all elementary streams that are referred to by this object descriptor stream.

8.8.4 IPMP of Scene Description streams

Scene description streams are treated like any media stream, i.e. they may be managed by an IPMP System.

An IPMP_Descriptor associated with a scene description stream implies that the IPMP System controls this scene description stream.

There are two ways to protect part of a scene description (or to apply different IPMP Systems to different components of a given scene):

The first method exploits the fact that it is permissible to have more than one scene description stream associated with one object descriptor (see 8.7.2.2). Such a split of the scene description can be freely designed by a content author, for example, putting a basic scene description into the first stream and adding one or more additional scene description streams that enhance this basic scene using BIFS updates.

The second method is to structure the scene using one or more **Inline** nodes (see 9.4.2.62). Each **Inline** node refers to one or more additional scene description streams, each of which might use a different IPMP System.

8.8.5 Usage of URLs in managed and protected content

8.8.5.1 URLs in the BIFS Scene Description

ISO/IEC 14496 does not specify compliance points for content that uses BIFS URLs that do not point to an object descriptor. Equally, no normative way to apply an IPMP System to such links exists. The behavior of an IPMP-enabled terminal that encounters such links is undefined.

8.8.5.2 URLs in Object Descriptors

URLs in object descriptors point to other remote object descriptors. This merely constitutes an indirection and should not adversely affect the behavior of the IPMP System that might be invoked through this remote object descriptor.

NOTE — The only difference is that while the original site might be trusted, the referred one might not. Further corrective actions to guard against this condition are not in the scope of ISO/IEC 14496.

8.8.5.3 URLs in ES_Descriptors

URLs in ES_descriptors are used to access elementary streams remotely. This merely constitutes an indirection and therefore does not adversely affect the behavior of the IPMP System that might be invoked through this remote object descriptor.

NOTE — The only difference is that while the original site might be trusted, the referred one might not. Further corrective actions to guard against this condition are not in the scope of ISO/IEC 14496.

8.8.6 IPMP Decoding Process

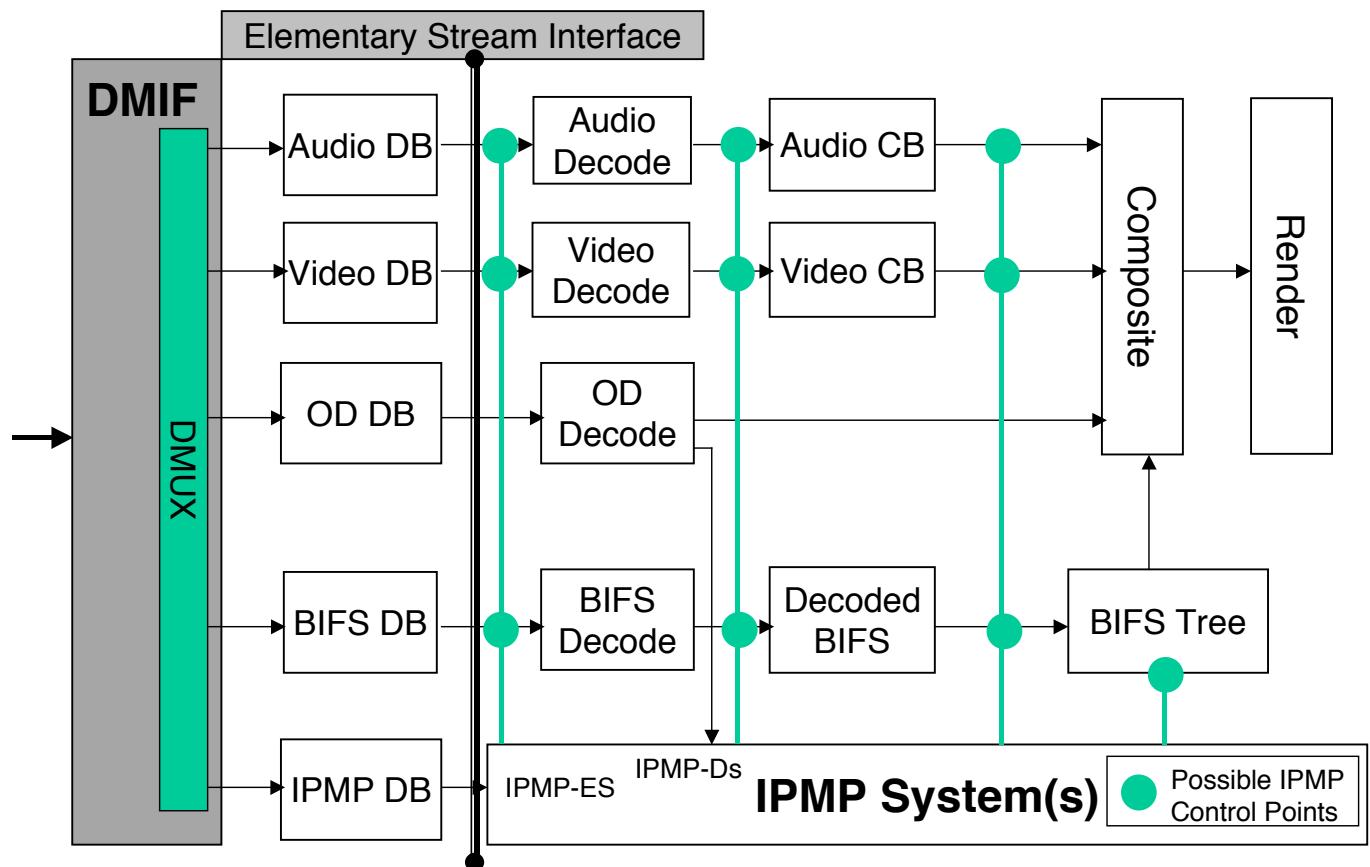


Figure 9 - IPMP system in the ISO/IEC 14496 terminal architecture

Figure 9 depicts the injection of an IPMP System with respect to the MPEG-4 terminal. IPMP System specific data is supplied to the IPMP System via IPMP streams and/or IPMP descriptors, and the IPMP system releases protected content *after the sync layer*.

Each elementary stream under the control of an IPMP System has the conceptual element of a *stream flow controller*. Stream flow control can take place between the SyncLayer decoder and the decoder buffer. As the figure indicates, elements of IPMP control may take place at other points in the terminal including, after decoding (as with some watermarking systems) or in the decoded BIFS stream, or after the composition buffers have been written, or in the BIFS scene tree. Stream flow controllers either enable or disable processing of an elementary stream in a non-normative way that depends on the status information provided by the IPMP System.

Finally, the IPMP System must at a minimum:

1. Process the IPMP stream and descriptor
2. Appropriately manage (e.g. decrypt and release) protected elementary streams.

The initialization process of the IPMP System is not specified except that it shall not unduly delay the content access process as specified in 8.7.3.

9 Scene Description

9.1 Introduction

9.1.1 Scope

ISO/IEC 14496 addresses the coding of audio-visual objects of various types: natural video and audio objects as well as textures, text, 2- and 3-dimensional graphics, and also synthetic music and sound effects. To reconstruct a multimedia scene at the terminal, it is hence not sufficient to transmit the raw audio-visual data to a receiving terminal. Additional information is needed in order to combine this audio-visual data at the terminal and construct and present to the end user a meaningful multimedia scene. This information, called scene description, determines the placement of audio-visual objects in space and time and is transmitted together with the coded objects as illustrated in Figure 10. Note that the scene description only describes the structure of the scene. The action of assembling these objects in the same representation space is called composition. The action of transforming these audio-visual objects from a common representation space to a specific presentation device (i.e., speakers and a viewing window) is called rendering.

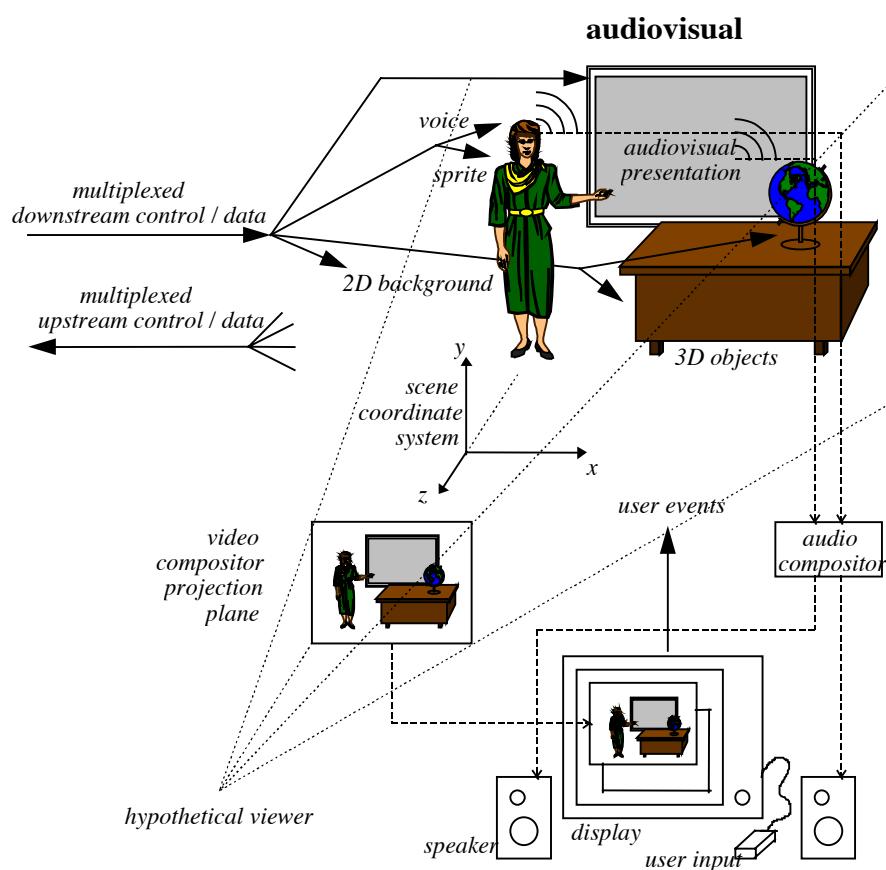


Figure 10 - An example of an object-based multimedia scene

Independent coding of different objects may achieve higher compression, and also brings the ability to manipulate content at the terminal. The behaviors of objects and their response to user inputs can thus also be represented in the scene description.

The scene description framework used in ISO/IEC 14496-1 is based largely on ISO/IEC 14772-1:1998 (Virtual Reality Modeling Language – VRML).

9.1.2 Composition and Rendering

ISO/IEC 14496-1 defines the syntax and semantics of bitstreams that describe the spatio-temporal relationships of audio-visual objects. For visual data, particular composition algorithms are not mandated since they are implementation-dependent; for audio data, subclause 9.2.2.13 and the semantics of the AudioBIFS nodes

normatively define the composition process. The manner in which the composed scene is presented to the user is not specified for audio or visual data. The scene description representation is termed “Binary Format for Scenes” (BIFS).

9.1.3 Scene Description

In order to facilitate the development of authoring, editing and interaction tools, scene descriptions are coded independently from the audio-visual media that form part of the scene. This permits modification of the scene without having to decode or process in any way the audio-visual media. The following clauses detail the scene description capabilities that are provided by ISO/IEC 14496-1.

9.1.3.1 Grouping of audio-visual objects

A scene description follows a hierarchical structure that can be represented as a graph. Nodes of the graph form audio-visual objects, as illustrated in Figure 11. The structure is not necessarily static; nodes may be added, deleted or be modified.

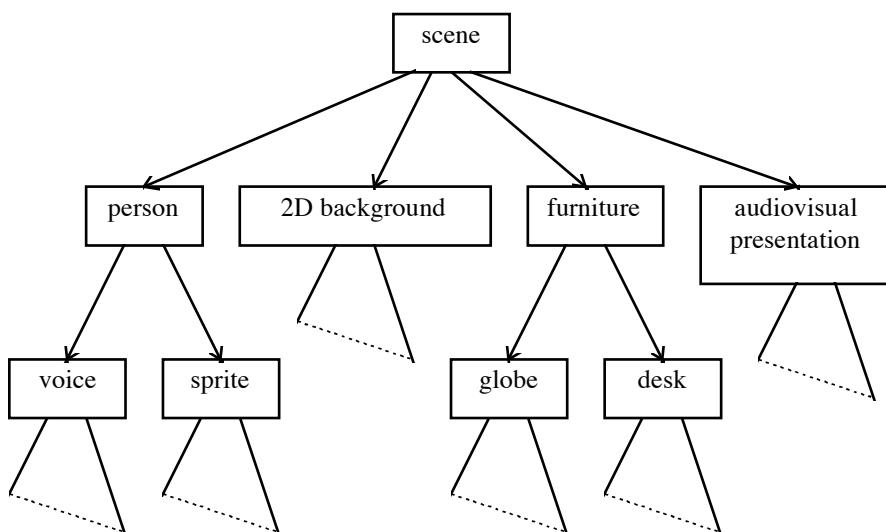


Figure 11 - Logical structure of example scene

9.1.3.2 Spatio-Temporal positioning of objects

Audio-visual objects have both a spatial and a temporal extent. Complex audio-visual objects are constructed by combining appropriate scene description nodes to build up the scene graph. Audio-visual objects may be located in 2D or 3D space. Each audio-visual object has a local co-ordinate system. A local co-ordinate system is one in which the audio-visual object has a pre-defined (but possibly varying) spatio-temporal location and scale (size and orientation). Audio-visual objects are positioned in a scene by specifying a co-ordinate transformation from the object's local co-ordinate system into another co-ordinate system defined by a parent node in the scene graph.

9.1.3.3 Attributes of audio-visual objects

Scene description nodes expose a set of parameters through which aspects of their appearance and behavior can be controlled.

EXAMPLE — the volume of a sound; the color of a synthetic visual object; the source of a streaming video.

9.1.3.4 Behavior of audio-visual objects

ISO/IEC 14496-1 provides tools for enabling dynamic scene behavior and user interaction with the presented content. User interaction can be separated into two major categories: client-side and server-side. Client-side interaction is an integral part of the scene description described herein. Server-side interaction is not dealt with.

Client-side interaction involves content manipulation that is handled locally at the end-user's terminal. It consists of the modification of attributes of scene objects according to specified user actions.

EXAMPLE — A user can click on a scene to start an animation or video sequence. The facilities for describing such interactive behavior are part of the scene description, thus ensuring the same behavior in all terminals conforming to ISO/IEC 14496-1.

9.2 Concepts

9.2.1 BIFS Elementary Streams

9.2.1.1 Overview

BIFS is a compact binary format representing a pre-defined set of audio-visual objects, their behaviors, and their spatio-temporal relationships. The BIFS scene description may, in general, be time-varying. Consequently, BIFS data is carried in a dedicated elementary stream and is subject to the provisions of the systems decoder model (see clause 7). Portions of BIFS data that become valid at a given point in time are contained in BIFS CommandFrames or AnimationFrames and are delivered within time-stamped access units. Note that the initial BIFS scene is sent as a BIFS-Command, although it is not required, in general, that a BIFS CommandFrame contains a complete BIFS scene description.

9.2.1.2 BIFS Decoder Configuration

BIFS configuration information is contained in a `BIFSConfig` (see 9.3.5.2) syntax structure, which is transmitted as `DecoderSpecificInfo` for the BIFS elementary stream in the corresponding object descriptor (see 8.6.7). This gives basic information that must be known by the terminal in order to parse the BIFS elementary stream. In particular, it indicates whether the stream consists of BIFS-Command or BIFS-Anim entities.

9.2.1.3 BIFS Access Units

A BIFS data access unit consists of one BIFS CommandFrame or AnimationFrame, as defined in 9.3.6.2 and 9.3.8.2, respectively. The BIFS CommandFrame or AnimationFrame shall convey all the data that is to be processed at any given instant in time. Access units in BIFS streams shall be labelled and time-stamped by suitable means. This shall be done via the related flags and the composition time stamps (CTS), respectively, in the SL packet header (see 10.2.4). The composition time indicates the point in time at which the CommandFrame or AnimationFrame embedded in a BIFS access unit shall become valid. This means that any changes to audio-visual objects that are described in the BIFS access unit will become visible or audible at precisely this time in an ideal compositor, unless a different behavior is specified by the fields of their nodes. Decoding and composition time for a BIFS access unit shall always have the same value.

An access unit does not necessarily convey a complete scene. In that case it just modifies the persistent state of the scene description. However, if an access unit conveys a complete scene as required at a given point in time it shall set the `randomAccessPointFlag` in the SL packet header to '1' for this access unit. Otherwise, the `randomAccessPointFlag` shall be set to '0'.

9.2.1.4 Time base for BIFS streams

The time base associated to a BIFS stream shall be indicated by suitable means. This shall be done by means of object clock reference time stamps in the SL packet headers (see 10.2.4) for this stream or by indicating the elementary stream from which this BIFS stream inherits the time base (see 10.2.3). All time stamps in the SL-packetized BIFS stream refer to this time base.

9.2.1.5 Multiple BIFS streams

Scene description data may be conveyed in more than one BIFS elementary streams. Two distinct mechanisms exist to associate a set of BIFS elementary streams to a single scene.

The first method uses **Inline** nodes (see 9.4.2.62) in a BIFS scene description. Each such node refers to further BIFS elementary streams. In this case, multiple BIFS streams have a hierarchical dependency. Each **Inline** node opens a new name scope for the identifiers used to label BIFS elements (`nodeID`, `ROUTEID`, `objectDescriptorID`). Therefore, it is not possible to pass events between parts of a scene that reside below different **Inline** nodes.

EXAMPLE 1 — An application of hierarchical BIFS streams is a multi-user virtual conferencing scene, where sub-scenes originate from different sources. Usually, it is neither possible nor useful to specify interaction between two such disjoint parts of the scene.

The second method to associate multiple BIFS elementary streams to a single scene is to group their elementary stream descriptors in a single object descriptor (see 8.7.2.2). In this case, these BIFS streams share the same scope for the identifiers they use (nodeID, ROUTEID, objectDescriptorID). This allows a single scene to be partitioned into multiple streams.

EXAMPLE 2 — An application may offer a presentation with different levels of detail, corresponding to different data rates and different computational complexity. By sharing the same name scope, the more detailed scene description can build on the simple one, rather than sending the entire scene again.

9.2.1.6 Time

9.2.1.6.1 Time-dependent nodes

The semantics of the **loop**, **startTime** and **stopTime** exposedFields and the **isActive** eventOut in time-dependent nodes are as described in ISO/IEC 14772-1:1998, subclause 4.6.9. **startTime**, **stopTime** and **loop** apply only to the local start, pause and restart of media and do not affect the delivery of the stream attached to the time dependent node. ISO/IEC 14496-1 has the following time-dependent nodes: **AnimationStream**, **AudioBuffer**, **AudioClip**, **AudioSource**, **MovieTexture** and **TimeSensor**.

9.2.1.6.2 Time fields in BIFS nodes

Several BIFS nodes have fields of type SFTime that identify a point in time at which an event occurs (change of a parameter value, start of a media stream, etc). Depending on the individual field semantics, these fields may contain time values that refer either to an absolute position on the time line of the BIFS stream or that define a time duration.

As defined in 9.2.1.4, the speed of the flow of time for events in a BIFS stream is determined by the time base of the BIFS stream. This determines unambiguously durations expressed by relative SFTime values like the **cycleTime** field of the **TimeSensor** node.

The semantics of some SFTime fields is such that the time values shall represent an absolute position on the time line of the BIFS stream (e.g. **startTime** in **MovieTexture**). This absolute position is defined as follows:

Each node in the scene description has an associated point in time at which it is inserted in the scene graph or at which an SFTime field in such a node is updated through a **CommandFrame** in a BIFS access unit (see 9.2.1.3). The value in the SFTime field as coded in the delivered BIFS command is the positive offset from this point in time in seconds. The absolute position on the time line shall therefore be calculated as the sum of the composition time of the BIFS access unit and the value of the SFTime field.

NOTE 1 — Absolute time in ISO/IEC 14772-1:1998 is defined slightly differently. Due to the non-streamed nature of the scene description in that case, absolute time corresponds to wallclock time in ISO/IEC 14772-1.

NOTE 2 — The SFTime fields that define the start or stop of a media stream are relative to the BIFS time base. If the time base of the media stream is a different one, it is not generally possible to set a **startTime** that corresponds exactly to the composition time of a composition unit of this media stream.

EXAMPLE — The example in Figure 12 shows a BIFS access unit that is to become valid at CTS. It conveys a node that has an associated media elementary stream. The startTime of this node is set to a positive value Δt . Hence, startTime will occur Δt seconds after the CTS of the BIFS access unit that has incorporated this node (or the value of the startTime field) in the scene graph.

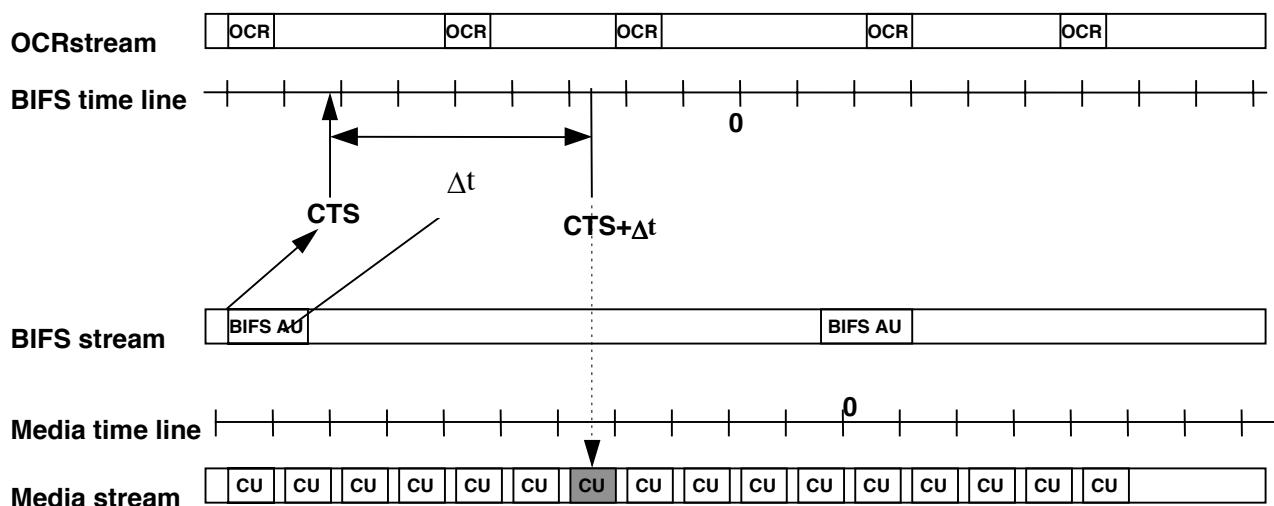


Figure 12 - Media start times and CTS

9.2.2 BIFS Scene Graph

9.2.2.1 Structure of the BIFS scene graph

Conceptually, BIFS scenes represent (as in ISO/IEC 14772-1:1998) a set of visual and audio primitives distributed in a directed acyclic graph, in a 3D space. However, BIFS scenes may fall into several sub-categories representing particular cases of this conceptual model. In particular, BIFS scene descriptions support scenes composed of:

- 2D primitives (only)
- 3D primitives (only)
- A combination of 2D and 3D primitives
- Audio primitives (only)

In scenes combining 2D and 3D primitives, the following possibilities exist:

- Complete 2D and 3D scenes layered in a 2D space with depth
- 2D and 3D scenes used as texture maps for 2D or 3D primitives
- 2D scenes drawn in the local X-Y plane of the local co-ordinate system in a 3D scene

Figure 13 describes a typical BIFS scene structure.

A BIFS scene shall start with one of the following nodes: **OrderedGroup**, **Group**, **Layer2D**, **Layer3D**. When the profile used enables visual elements to be composed, the first node indicates the co-ordinate system and context (2D or 3D) to be used for the children of that node. The following rules apply:

- Scene starts with a **Layer2D** or **OrderedGroup** node: A 2D co-ordinate system and context is assumed.
- Scene starts with a **Layer3D** or **Group** node : A 3D co-ordinate system and context is assumed.

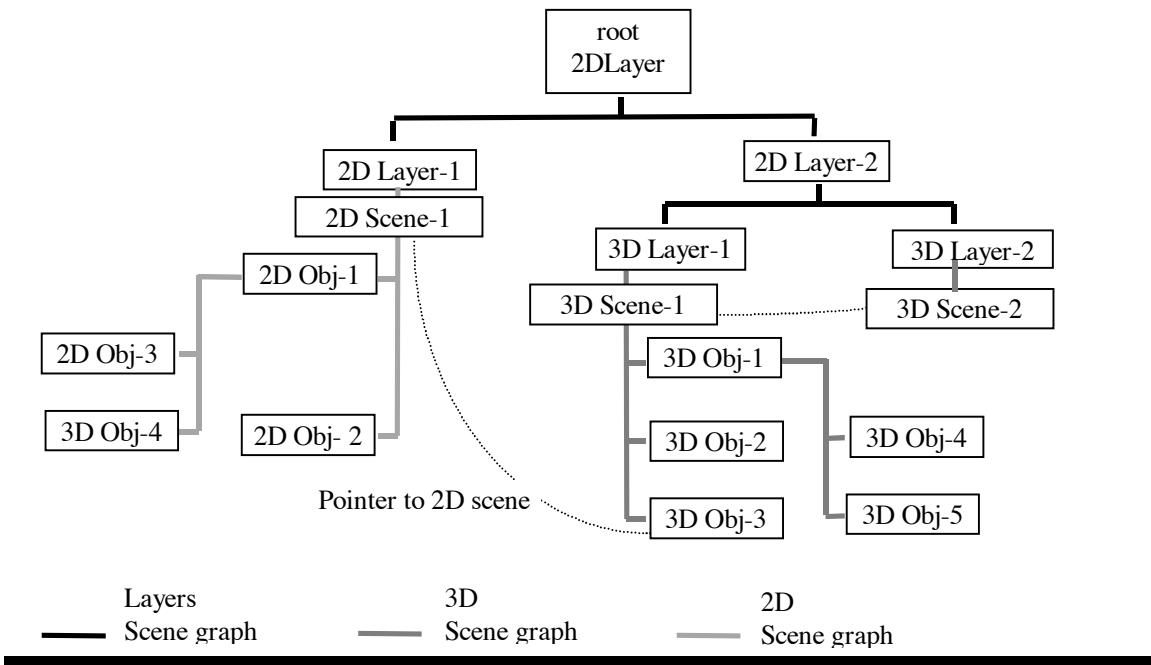


Figure 13 - Scene graph example.

The hierarchy of three different scene graphs is shown: a 2D graphics scene graph and two 3D graphics scene graphs combined with the 2D scene via layer nodes. As shown in the picture, the 3D Layer-2 is the same scene as 3D Layer-1, but the viewpoint may be different. The 3D Obj-3 is an Appearance node that uses the 2D Scene-1 as a texture node.

9.2.2.2 2D Co-ordinate System

The origin of the 2D co-ordinate system is positioned in the center of the rendering area, the x-axis is positive to the right, and the y-axis is positive upwards.

The width of the rendering area represents -1.0 to +1.0 (meters) on the x-axis (see Figure 14). The extent of the y-axis in the positive and negative directions is determined by the aspect ratio of the rendering area so that the unit of distance is equal in both directions. The rendering area is either the entire screen, or window on a computer screen, when viewing a single 2D scene, or the rectangular area defined by the texture used in a **CompositeTexture2D** node, or a **Layer2D** node that contains a subordinate 2D scene description.

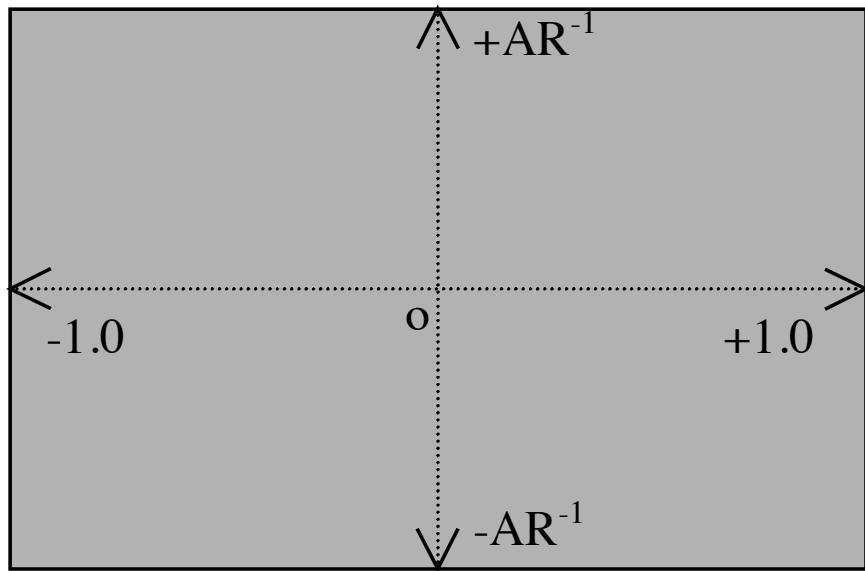


Figure 14 - 2D co-ordinate system (AR = Aspect Ratio)

9.2.2.3 3D Co-ordinate System

The 3D co-ordinate system is as described in ISO/IEC 14772-1:1998, subclause 4.4.5. When 2D objects are described in a 3D space, they are drawn in the local (x,y) plane ($z=0$), and the units used are those of the 3D co-ordinate system for the x and y directions.

9.2.2.4 Mixing 2D and 3D scenes

A single BIFS scene may contain both 2D and 3D elements. The following methods exist:

- 2D primitives may be placed in a 3D scene graph. In this case, the 2D primitives are drawn in the local (x,y) plane, and use the local coordinate system, restricted to this (x,y) plane.
- 2D and 3D scenes may be composed and overlapped on the screen using **Layer2D** and **Layer3D** nodes. This is useful, for instance, when it is desirable to have 2D interfaces to 3D worlds ("head up" display), or a 3D insert in a 2D scene.
- 2D and 3D scenes may be mapped onto any given geometry using the **CompositeTexture2D** and **CompositeTexture3D** nodes. For instance, 2D scenes may be mapped onto animated 3D geometry to perform special effects.

9.2.2.5 Drawing Order

It is possible to specify the drawing order of elements of the scene, using the **OrderedGroup** node. This feature may be used for 2D or 3D scenes. 2D scenes are considered to have zero depth. Nonetheless, it is important to be able to specify the order in which 2D objects are composed, in order to describe their apparent depths. 3D scenes may use the drawing order facility to solve conflicts of coplanar polygons or other rendering optimizations.

The following rules determine the drawing order, including conflict resolution for objects having the same drawing order:

1. The object having the lowest drawing order shall be drawn first (taking into account negative values).
2. Objects having the same drawing order shall be drawn in the order in which they appear in the scene description.

9.2.2.6 Pixel and Meter metrics

In addition to meter-based metrics, it is also possible to use pixel-based metrics. In this case, 1 meter is set to be equal to the distance between two pixels. This applies to both the horizontal (x-axis) and vertical (y-axis) directions.

The selection of the appropriate metrics is performed by the content creator. In particular, it is controlled by the BIFSConfig syntax (see 9.3.5.2).

When **pixelMetric** is set to 1, pixel metrics shall be used for the entire scene. This implies that rendered node sizes (such as for a Rectangle) and rendered node positions are integers. If non-integer values appear due to for example scaling, rounding shall be implied towards -infinity.

9.2.2.7 Nodes and fields

9.2.2.7.1 Nodes

The BIFS scene description consists of a collection of nodes that describe the scene structure. An audio-visual object in the scene is described by one or more nodes, which may be grouped together (using a grouping node). Nodes are grouped into node data types (NDTs) and the exact type of the node is specified using a **nodeType** field.

An audio-visual object may be completely described within the BIFS information, e.g. **Box** with **Appearance**, or may also require elementary stream data from one or more audio-visual objects, e.g. **MovieTexture** or **AudioSource**. In the latter case, the node includes a reference to an object descriptor that indicates which elementary stream(s) is (are) associated with the node, or directly to a URL description (see ISO/IEC 14772-1:1998, subclause 4.5.2). With the exception of the **Anchor** and **Script** nodes, a **url** field may only refer to content that conforms to a valid profile and level for the terminal.

9.2.2.7.2 Fields and Events

See ISO/IEC 14772-1:1998, subclause 5.1.

9.2.2.8 Internal, ASCII and Binary Representation of Scenes

ISO/IEC 14496-1 describes the attributes of audio-visual objects using node structures and fields. These fields can be one of several types (see 9.2.2.7.2). To facilitate animation of the content and modification of the objects' attributes in time, within the terminal, it is necessary to use an internal representation of nodes and fields as described in the node specifications (see 9.4). This is essential to ensure deterministic behaviour in the terminal's compositor, for instance when applying ROUTEs or differentially coded BIFS-Anim frames. The observable behaviour of compliant terminals shall not be affected by the way in which they internally represent and transform data; that is, they shall behave as if their internal representation is as defined herein.

However, when encoding the BIFS scene description, different attributes may need to be quantized or compressed appropriately. Thus, the binary representation of fields may differ according to the types of fields, or according to the precision needed to represent a given audio-visual object's attributes. The semantics of nodes are described in 9.4. The binary syntax which represents the binary format as transported in streams conforming to ISO/IEC 14496-1 is provided in 9.3 and uses the node coding parameters provided in Annex H.

9.2.2.8.1 Binary Syntax Overview

9.2.2.8.1.1 Scene Description

The entire scene is represented by a binary encoding of the scene graph. This encoding restricts the VRML grammar as defined in ISO/IEC 14772-1:1997, Annex A, but still enables the representation of any scene that can be generated by this grammar.

EXAMPLE — One example of the grammatical differences is the fact that all ROUTEs are represented at the end of a BIFS scene, and that a global grouping node is required at the top level of the scene.

9.2.2.8.1.2 Node Description

Node types are encoded according to the context of the node. This improves efficiency by exploiting the fact that not all nodes are valid at all places in the scene graph. In many instances, only one of a subset of all BIFS nodes is valid at a particular place in the scene graph, and hence in the bitstream.

9.2.2.8.1.3 Fields description

Fields may be quantized to improve compression efficiency. Several aspects of the inverse quantization process can be controlled by adjusting the parameters of the **QuantizationParameter** node.

9.2.2.8.1.4 ROUTE description

All ROUTEs are described at the end of the scene. This improves bit efficiency by grouping these elements in a single location in the bitstream and removes the need for switches in the syntax to allow ROUTEs and nodes to be described in a mixed format.

9.2.2.9 Basic Data Types

There are two general classes of fields and events: fields/events that contain a single value (e.g. a single number or a vector), and fields/events that contain multiple values. Multiple-valued fields/events have names that begin with MF, whereas single valued begin with SF.

9.2.2.9.1 Numerical data and string data types

9.2.2.9.1.1 Introduction

For each basic data type, single field and multiple field data types are defined in ISO/IEC 14772-1:1998, subclause 5.2. Some further restrictions are described herein.

9.2.2.9.1.2 SFInt32/MFInt32

When routing values between two SFInt32s note shall be taken of the valid range of the destination. If the value being conveyed is outside the valid range, it shall be clipped to be equal to either the maximum or minimum value of the valid range, as follows:

```
if x > max, x := max
if x < min, x := min
```

9.2.2.9.1.3 SFTime

The SFTime field and event specifies a single time value. Time values shall consist of 64-bit floating point numbers indicating a duration in seconds or the number of seconds elapsed since the origin of time as defined in the semantics for each SFTime field.

9.2.2.9.2 Node data types

Nodes in the scene are also represented by a data type, namely SFNode and MFNode types. ISO/IEC 14496-1 also defines a set of sub-types, such as SFColorNode, SFMaterialNode. These node data types (NDTs) allow efficient binary representation of BIFS scenes, taking into account the usage context to achieve better compression. However, the generic SFNode and MFNode types are sufficient for internal representations of BIFS scenes.

9.2.2.10 Attaching nodeIDs to nodes

Each node in a BIFS scene graph may have a nodeID associated with it, to be used for referencing. ISO/IEC 14772-1:1998, subclause 4.6.2, describes the DEF statement which is used to attach names to nodes. In BIFS scenes, an integer value is used for the same purpose for nodeIDs. The number of bits used to represent these integer values is specified in the BIFSConfig syntax (see 9.3.5.2).

The following restrictions apply:

- a) Nodes are identified by the use of nodeIDs, which are binary numbers conveyed in the BIFS bitstream.
- b) The scope of nodeIDs is given in 9.2.1.5.
- c) No two nodes in the scene graph may have the same nodeID at any point in time.

Nodes that have been assigned a nodeID may be re-used, as described in ISO/IEC 14772-1:1998, subclause 4.6.3. Note that this mechanism results in a scene description that is a directed acyclic graph, rather than a simple tree.

The mechanisms that allow modifications to the BIFS scene also depend on the use of nodeIDs (see 9.2.2.10).

9.2.2.11 Standard Units

As described in ISO/IEC 14772-1:1998, subclause 4.4.5, the standard units used in the scene description are the following:

Table 14 - Standard units

| Category | Unit |
|-------------|-----------------------|
| Distance | Meter |
| Color Space | RGB [0,1] [0,1] [0,1] |
| Time | Seconds |
| Angle | Radians |

9.2.2.12 Mapping of Scenes to Screens

BIFS scenes may contain still images and videos that are to be pixel-copied to the rendering device using their native dimensions as produced at the output of their terminals. The **Bitmap** node (see 9.4.2.19) provides a screen-aligned geometry that has the pixel dimensions of the texture that is mapped onto it.

NOTE — When **Bitmap** is used, the same scene will appear differently on screens with different resolutions. BIFS scenes that do not use the **Bitmap** node are independent from the screen on which they are viewed.

9.2.2.12.1 Transparency of visual objects

Content complying with ISO/IEC 14496-1 may include still images or video sequences with representations that include alpha values. These values provide transparency information and are to be treated as specified in ISO/IEC 14772-1:1998, subclause 4.14. For video sequences represented according to ISO/IEC 14496-2, transparency is handled as specified in ISO/IEC 14496-2.

9.2.2.13 Special considerations for audio

9.2.2.13.1 Audio sub-graphs

Audio nodes are used to build audio scenes in the terminal from audio sources coded with tools specified in ISO/IEC 14496-3. The audio scene description capabilities provide two functionalities:

- “Physical modelling” composition for virtual-reality applications, where the goal is to recreate the acoustic space of a real or virtual environment.
- “Post-production” composition for traditional content applications, where the goal is to apply high-quality signal processing transformations.

Audio may be included in either 2D or 3D scene graphs. In a 3D scene, the audio may be spatially presented to sound as though it originates from a particular 3D direction, according to the positions of the object and the listener.

The **Sound** and **DirectiveSound** nodes are used to attach audio to 3D scene graphs and the **Sound2D** node is used to attach audio to 2D scene graphs. As with visual objects, an audio object represented by one of these nodes has a position in space and time, and is transformed by the spatial and grouping transforms of nodes hierarchically above it in the scene.

The nodes below the **Sound/DirectiveSound/Sound2D** nodes, however, constitute an audio sub-graph. This sub-graph is used to describe a particular audio object through the mixing and processing of several audio streams. Rather than representing a hierarchy of spatio-temporal transformations, the nodes within the audio sub-graph represent a signal flow graph that describes how to create the audio object from the audio coded in the **AudioSource** streams. That is, each audio sub-graph node (**AudioSource**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip**, **AudioBuffer**, **AudioDelay**) accepts one or several channels of input audio, and describes how to turn these channels of input audio into one or more channels of output. The only sounds presented in the audio-visual scene are those which are the output of audio nodes that are children of a **Sound/DirectiveSound/Sound2D** node (that is, the “highest” outputs in the audio sub-graph). The remaining nodes represent “intermediate results” in the sound computation process and the sound represented therein is not presented to the user.

The normative semantics of each of the audio sub-graph nodes describe the exact manner in which to compute the output audio the input audio for each node based on its parameters.

9.2.2.13.2 Overview of sound node semantics

This subclause describes the concepts for normative calculation of the audio objects in the scene in detail, and describes the normative procedure for calculating the audio signal which is the output of a **Sound/DirectiveSound/Sound2D** node given the audio signals which are its input.

Recall that the audio nodes present in an audio sub-graph do not each represent a sound to be presented in the scene. Rather, the audio sub-graph represents a signal-flow graph which computes a single (possibly multi-channel) audio object based on a set of audio inputs (in **AudioSource** nodes) and parametric transformations. The only sounds which are presented to the listener are those which are the “output” of these audio sub-graphs, as connected to a **Sound/DirectiveSound/Sound2D** node. This subclause describes the proper computation of this signal-flow graph and resulting audio object.

As each audio source is decoded, it produces data that is stored in composition memory (CM). At a particular time instant in the scene, the compositor shall receive from each audio decoder a CM such that the decoded time of the first audio sample of the CM for each audio source is the same (that is, the first sample is synchronized at this time instant). Each CM will have a certain length, depending on the sampling rate of the audio source and the clock rate of the system. In addition, each CM has a certain number of channels, depending on the audio source.

Each node in the audio sub-graph has an associated input buffer and output buffer, except for the **AudioSource** node which has no input buffer. The CM for the audio source acts as the input buffer of audio for the **AudioSource** with which the decoder is associated. As with CM, each input and output buffer for each node has a certain length, and a certain number of channels.

As the signal-flow graph computation proceeds, the output buffer of each node is placed in the input buffer of its parent node, as follows:

If an audio node, N , has n children, and each of the children produces $k(i)$ channels of output, for $1 \leq i \leq n$, then the node, N , shall have $k(1) + k(2) + \dots + k(n)$ channels of input, where the first $k(1)$ channels [number 1 through $k(1)$] shall be the channels of the first child, the next $k(2)$ channels [number $k(1)+1$ through $k(1)+k(2)$] shall be the channels of the second child, and so forth.

Then, the output buffer of the node is calculated from the input buffer based on the particular rules for that node.

9.2.2.13.2.1 Sample-rate conversion

If the various children of a **Sound/ DirectiveSound/Sound2D** node do not produce output at the same sampling rate, then the lengths of the output buffers of the children do not match, and the sampling rates of the children’s output must be brought into alignment in order to place their output buffers in the input buffer of the parent node. The sampling rate of the input buffer for the node shall be the fastest of the sampling rates of the children. The output buffers of the children shall be resampled to be at this sampling rate. The particular method of resampling is non-normative, but the quality shall be close in accuracy to the DAC that the signal is targeted for, i.e. according to the rule $\text{dB SNR} = 6 * (\text{nbits} - 1)$, where nbits is the number of bits corresponding to the maximum bit depth of any of the signals being so converted and/or composited. Aliasing artifacts may be at this level of signal-to-noise ratio. The noise level due to arithmetic accuracy and other uncorrelated noise sources should be below the rule $\text{dB SNR} = 6 * \text{nbits}$.

The output sampling rate of a node shall be the output sampling rate of the input buffers after this resampling procedure is applied.

Content authors are advised that content which contains audio sources operating at many different sampling rates, especially sampling rates which are not related by simple rational values, may produce scenes with a high computational complexity.

EXAMPLE — Suppose that node N has children M1 and M2, all three audio nodes, and that M1 and M2 produce output at S1 and S2 sampling rates respectively, where $S_1 > S_2$. Then if the decoding frame rate is F frames per second, then M1's output buffer will contain S_1/F samples of data, and M2's output buffer will contain S_2/F samples of data. Then, since M1 is the faster of the children, its output buffer values are placed in the input buffer of N. The output buffer of M2 is resampled by the factor S_1/S_2 to be S_1/F samples long, and these values are placed in the input buffer of N. The output sampling rate of N is S1.

9.2.2.13.2.2 Number of output channels

If the **numChan** field of an audio node, which indicates the number of output channels, differs from the number of channels produced according to the calculation procedure in the node description, or if the **numChan** field of an **AudioSource** node differs in value from the number of channels of an input audio stream, then the **numChan** field shall take precedence when including the source in the audio sub-graph calculation, as follows:

- If the value of the **numChan** field is strictly less than the number of channels produced, then only the first **numChan** channels shall be used in the output buffer.
- If the value of the **numChan** field is strictly greater than the number of channels produced, then the “extra” channels shall be set to all 0's in the output buffer.

9.2.2.13.3 Audio-specific BIFS Nodes

In the following table, nodes that are related to audio scene description are listed.

Table 15 - Audio-Specific BIFS Nodes

| Node | Purpose | Subclause |
|--|---|------------------------------------|
| AudioBuffer | Interactively trigger snippets of sound | 9.4.2.6 |
| AudioClip | Insert an audio clip into a scene | 9.4.2.8 |
| AudioDelay | Add delay to sound | 9.4.2.9 |
| AudioMix | Mix sounds | 9.4.2.11 |
| AudioSource | Define audio source input to a scene | 9.4.2.12 |
| AudioFX | Apply post-production effects to sound | 9.4.2.10 |
| AudioSwitch | Switching of audio sources in a scene | 9.4.2.13 |
| ListeningPoint | Define listening point in a scene | 9.4.2.67 |
| Sound, Sound2D, DirectiveSound | Define properties of sound | 9.4.2.94, 9.4.2.95, 9.4.2.39 |

9.2.2.13.4. Spatialization of sound sources according to the acoustic environment

This specification contains a set of nodes of extended node types, that can be used to include positional and directive sound sources to 3-D BIFS scenes, and process them in a way that the acoustics of the environment is taken into account. These nodes enable parametrization and rendering of the acoustic properties of a virtual environment according to the current relative positions of the sound source, the listening point, and the acoustically relevant objects in the BIFS scene. Such properties are, e.g., room reverberation time (and other statistical room acoustic parameters), speed of sound, acoustic properties of surfaces, and sound source directivity. Functionalities that are made possible with these parameters include immersive audiovisual rendering, room acoustic modeling, and enhanced 3-D sound presentation.

Two distinct approaches of acoustic environment rendering are incorporated in the 3-D sound processing. One is based on physical, or geometrical modeling of the acoustic scene while the second is based on the perceptual description of room acoustic effects. These two schemes of virtual acoustics rendering are referred to as the *physical* and the *perceptual* approach.

The nodes that are involved in the sound environment modeling are **AcousticScene**, **AcousticMaterial**, **DirectiveSound**, and **PerceptualParameters**, and their main functionalities are presented in the table below, and the rendering scheme where they are used is listed in the rightmost column:

Table 16 - Nodes for environmental spatialization of sound

| Node | Purpose | Approach | Subclause |
|-----------------------------|--|-------------------------|-----------------|
| AcousticScene | Restrict each audio rendering process to a defined 3-D region in the BIFS scene, and specify a reverberation time that is applied to the sound sources currently within that region. | physical | 9.4.2.2 |
| AcousticMaterial | Define sound reflectivity and transmission properties (along with the visual properties) for each acoustically relevant (flat, polygonal) surface. | physical | 9.4.2.1 |
| DirectiveSound | Define a directive sound source that also enables natural distance dependent attenuation and air absorption modeling, as well as rendering of the propagation delay between the source and the listener. | physical and perceptual | 9.4.2.39 |
| PerceptualParameters | Node for attaching perceptual properties to a directive sound source (DirectiveSound) in order to simulate virtual room effects that do not need to relate to the geometrical and/or visual BIFS scene. | perceptual | 9.4.2.78 |

In the following, overviews of the physical and perceptual audio rendering schemes are presented.

9.2.2.13.4.1 Physical approach

In this approach the acoustics rendering is defined as creating a virtual auditory environment that models an existent or non-existent space. This rendering is called *auralization*, the relation of which to graphics (visualization) is understood as the creation of audiovisual scenes that are perceptually (visually and aurally) relevant. An example of this could be a virtual concert performance, where the acoustical behavior of the space as well as the graphical outlook is modeled. Another example could be a scene, where the listener moves from a very small room to a larger hall, and the changes in the acoustic and graphical rendering is immediately perceived. Also sound sources without a room acoustic response but with effects such as source directivity, Doppler effect, and echoes (distinctive sound reflections) can be modeled. The acoustical behaviors and properties are:

- Acoustic properties of surface materials (walls), that enable modeling of sound reflections of surfaces, as well as transmission of sound through them. This way sound reflections are tracked and rendered according to the geometry of the walls and positions of the sound sources and the listener. Obstruction effects are automatically rendered when walls or obstacles are present between the source and the listener.
- Reverberation time of a specified region in the scene. This enables modeling of reverberating spaces by a simple parameter, and without the necessary need to describe the physical walls of a room.
- Acoustic properties of the sound transmitting medium. These include the speed of sound, distance dependent attenuation and lowpass filtering effect caused by air absorption (see ISO 9613-1:1993). Speed of sound is used to control the sound propagation delay between source and the listener, and therefore also the strength of the Doppler effect which depends on the relative motion between the source and the listener.
- Directivity characteristics of sound sources. This enables flexible modeling of different sound sources (e.g., human speaker, or a musical instrument). The directivity patterns can be frequency dependent, or it can be defined by a direction dependent coefficient, or in the simplest case the source can be omnidirectional.

In the physical approach, the *geometrical* and *physical sound propagation operator* is used in real time during playback in order to derive the auralization signal processing parameters to be applied to each sound source signal. This propagation operator exploits the knowledge of the positions of the sound sources and the listener relative to the walls to compute the arrival time, amplitude (and spectrum) and direction of arrival for each early

reflection. This computation is performed in real time for a limited number of reflections per sound source, with dynamic refresh of reflection parameters according to movements of the sound sources or the listener.

9.2.2.13.4.2 Perceptual approach

In this model, the sound transformation associated with room reflections and reverberation is described by a set of perceptual attributes (such as source presence and brilliance, room reverberance, envelopment). These attributes may be manipulated directly and individually for each sound source in the scene.

This approach provides simple and intuitive parameters to the content provider, allowing:

- Manipulation of environmental effects for each sound event directly (without requiring that the source or the point of view be moved).
- Sound design adjustments beyond the physical constraints implied by the graphic representation, for example:
 - Distorted or exaggerated distance sensation and room-related effects
 - Unconstrained spatial sound effects for audio-only scene nodes (no visual correspondence) or when the point of view is out of the room

In this approach, an absolute (exocentric) representation of the sound scene containing several sources and the listener can be manipulated as follows:

- The environment (room) is described by setting the values of the perceptual attributes for a reference source-listener distance. These attributes and their values make up a "preset", which specifies, at that reference distance and for an omnidirectional sound source, the delay and intensity of the early reflection, as well as the delay, decay time and spectrum of the late reverberation.
- The sound transformation to be applied to each sound event is derived from the above preset by use of a *perceptual sound propagation operator* which takes into account the relative positions and orientations of the sources and the listener, and a model of the directivity of sound sources.

In this model, only the *relative* positions and orientations of the sound sources with respect to the listener are taken into account. The model does not exploit any knowledge of wall positions in order to compute the parameters of the early reflections. The temporal pattern of the early reflections is determined by the definition of the environment "preset". The perceptual sound propagation operator adjusts one perceptual attribute (called "source presence") according to source-listener distance. Adjusting this single parameter produces a convincing sensation of proximity or remoteness of the sound source. Additionally, the operator takes into account the orientation of the source and its directivity pattern.

9.2.3 Sources of modification to the scene

9.2.3.1 Interactivity and behaviors

To describe interactivity and behavior of scene objects, the event architecture defined in ISO/IEC 14772-1:1998, subclause 4.10, is used. Sensors and routes describe interactivity and behaviors. Sensor nodes generate events based on user interaction or a change in the scene. These events are routed to interpolator or other nodes to change the attributes of these nodes. If routed to an interpolator, a new parameter is interpolated according to the input value, and is finally routed to the node which must process the event.

9.2.3.1.1 Attaching ROUTEIDs to routes

ROUTEIDs may be attached to routes using the DEF mechanism, described in ISO/IEC 14772-1:1998, subclause 4.6.2. This allows routes to be subsequently referenced in BIFS-Command structures. ROUTEIDs are integer values and the namespace for routes is distinct from that of nodeIDs. The number of bits used to represent these integer values is specified in the BIFS DecoderConfigDescriptor.

The scope of ROUTEIDs is defined in see 9.2.1.5. The following restrictions apply:

- a) Routes are identified by the use of ROUTEIDs, which are binary numbers conveyed in the BIFS bitstream.

- b) The scope of ROUTEIDs is given in 9.2.1.5.
- c) No two routes in the scene graph may have the same ROUTEID at any point in time.

The mechanisms that allow modifications to the BIFS scene also depend on the use of nodeIDs (see 9.2.2.10). The USE mechanism shall not be used with routes.

9.2.3.1.2 Conditional node

The **Conditional** node (see 9.4.2.30) allows BIFS-Commands to be described in the scene which shall only be applied to the scene graph when an event is received on one of the **Conditional** node's inputs.

9.2.3.2 External modification of the scene: BIFS-Commands

The BIFS-Command mechanism enables the change of properties of the scene graph, its nodes and behaviors.

EXAMPLE — **Transform** nodes can be modified to move objects in space; **Material** nodes can be changed to modify an object's appearance, and fields of geometric nodes can be totally or partially changed to modify the geometry of objects.

9.2.3.2.1 Overview

BIFS-Commands are used to modify a set of properties of the scene at a given time instant in time. Commands are grouped into CommandFrames (see 9.3.6.2) in order to be able to send several commands in a single access unit. The following four basic commands are defined:

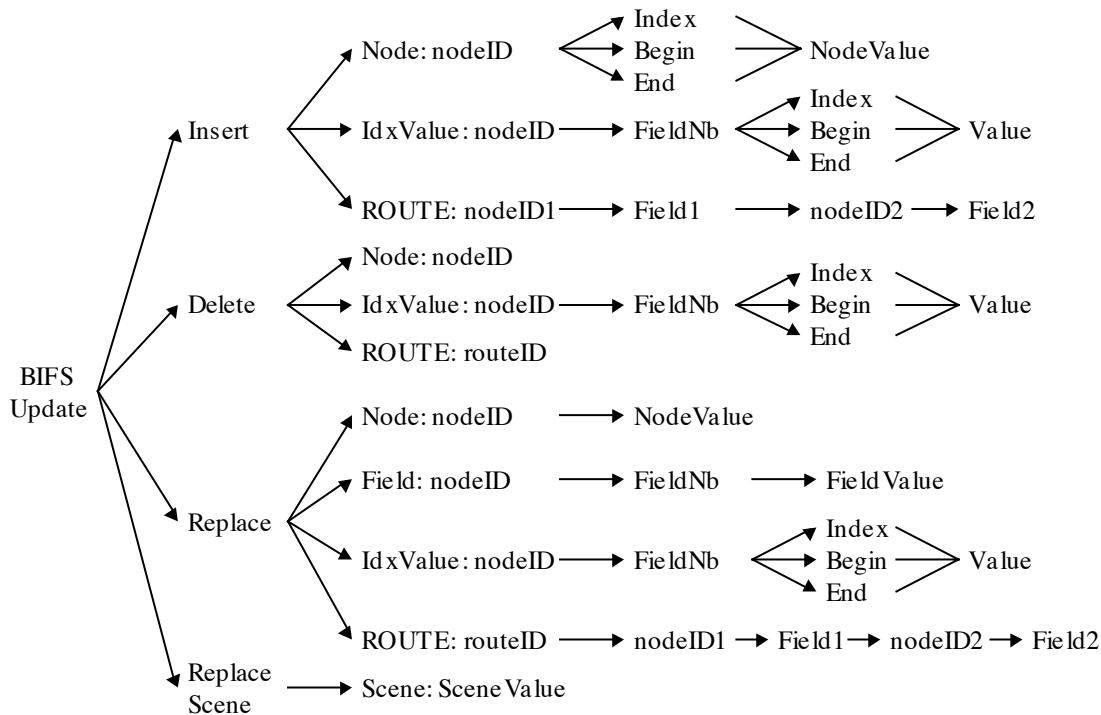
1. Replacement of an entire scene
2. Insertion
3. Deletion
4. Replacement

The first of these commands allows the replacement of the entire BIFS scene. The replacement of the entire scene requires a scene graph representing a valid BIFS scene to be transmitted. The SceneReplace command is the only random access point in the BIFS stream.

The other three commands can be used to update the following structures:

1. A node
2. An eventIn, exposedField or an indexed value in an MFField
3. A ROUTE

In order to modify the scene the sender must transmit a BIFS CommandFrame that contains one or more update commands. A single source of BIFS-Commands is assumed. The identification of a node in the scene is provided by a nodeID. Note that it is the sender's responsibility to provide this nodeID, which must be unique (see 9.2.1.5). The identification of a node's fields is provided by sending the INid of the field (see Annex H).

**Figure 15 - BIFS-Command Types**

9.2.3.2.2 Modification of indexed values

Insertion of an indexed value in a field implies that all later values in the field have their indices incremented and the length of the field increases accordingly. Appending a value to an indexed value field also increases the length of the field but the indices of existing values in the field do not change.

Deletion of an indexed value in a field implies that all later values in the field have their indices decremented and the length of the field decreases accordingly.

9.2.3.2.3 Timing of BIFS-Commands

The time at which a BIFS-Command is applied shall be the composition time stamp of the access unit in which the command is contained, as defined in the sync layer (see 10.2).

9.2.3.3 External animation of the scene: BIFS-Anim

BIFS-Anim provides for the continuous update of the certain fields of nodes in the scene graph. BIFS-Anim is used to integrate different kinds of animation, including the ability to animate face models as well as meshes, 2D and 3D positions, rotations, scale factors, and color attributes. Although BIFS-Anim and BIFS-Command have the same elementary stream type (see Table 9) they may not occupy the same elementary stream. BIFS-Anim information is conveyed in a separate elementary stream from that which carries BIFS-Command elements.

9.2.3.3.1 Overview

BIFS-Anim elementary streams consist of a sequence of AnimationFrames. The AnimationMask, which is required to interpret these AnimationFrames, is transmitted in the DecoderSpecificInfo for the BIFS-Anim elementary stream in the corresponding object descriptor (see 8.6.7).

9.2.3.3.2 BIFS-Anim configuration

The AnimationMask contains one ElementaryMask for each node that is to be animated. These ElementaryMasks specify the fields that are contained in the AnimationFrames for a given animated node, and their associated quantization parameters. Only eventIn or exposedField fields that have an animation method (see Annex H and 9.2.3.3.3) can be modified using BIFS-Anim. Such fields are called dynamic fields. In addition, the

animated field must be part of an updateable node; that is, a node that has been assigned a `nodeID`. The `AnimationMask` is composed of several elementary masks defining these parameters.

9.2.3.3 BIFS-Anim animation parameters

Animation parameters are transmitted as a sequence of `AnimationFrames`. `AnimationFrames` specify the values of the dynamic fields of updateable nodes that are being animated in BIFS-Anim streams. An `AnimationFrame` contains the new values of all animated parameters at a specified time, unless if it is specified that, for some frames, these parameters are not sent. The parameters can be sent in Intra (the absolute value is sent) and Predictive modes (the difference between the current and previous values is sent).

Animation parameters can be applied to any `eventIn` or `exposedField` of any updateable node of a scene which has an assigned animation method (see Annex H).

NOTE — Some node tables in Annex H contain an `eventIn` or `exposedField` that has an animation method but for which there is no associated `dynID`. This is the case when only one `exposedField` or `eventIn` in a node has an animation method. In such cases, it is not necessary for the field to have a `dynID` since the terminal can assume that BIFS-Anim animations for this type of node refer to the only dynamic field of the node.

The types of dynamic fields are:

- `SFInt32/MFInt32`
- `SFFloat/MFFloat`
- `SFRotation/MFRotation`
- `SFColor/MFCOLOR`
- `SFVec2f/MFVec2f`
- `SFVec3f/MFVec3f`

9.2.3.4 Order of application of modifications to the scene

Where modifications to the scene graph, resulting from the use of more than one of the permitted methods, must be applied simultaneously, the following order of application shall be observed:

1. BIFS-Anim
2. **Conditional** node
3. BIFS-Command

9.3 BIFS Syntax

9.3.1 Introduction

BIFS data consists of two distinct elements in the multiplexed bitstream. Terminal configuration information is first sent in the object descriptor. The remaining BIFS information is sent in a separate elementary stream.

The syntax and semantics of the terminal configuration is described in 9.3.5.2 and 9.3.5.3. Two different kinds of session can take place: a BIFS-Command session or a BIFS-Anim session.

If the session is a BIFS-Command session, a sequence of commands to modify the scene is sent. The syntax and semantics of these commands are described in 9.3.6.

If the session is a BIFS-Anim session, a sequence of animation data to change the values of specific fields in the scene is sent. The syntax and semantics of this session is described in 0.

9.3.2 Decoding tables, data structures and associated functions

9.3.2.1 Function of decoding tables, data structures and functions

This subclause describes tables and data structures used to contain necessary data, along with the associated functions, for decoding the BIFS elementary streams. These are not syntax elements but are descriptions, often in code or pseudo-code, of data and functions that are required to decode the bitstream. The tables and data structures may be known a priori at the terminal or may be constructed from data parsed from the bitstream. They are referenced throughout the syntax.

NOTE — The code or pseudo-code for the non-syntax data elements is purely notational and does not imply a normative requirement to use these code fragments in implementations.

Coding of individual nodes and field values is very regular, and follows a depth-first order (children or sub-nodes of a node are present in the bitstream before its siblings).

9.3.2.2 Node Data Type Tables

Identification of nodes and fields within a BIFS scene graph is context-dependent. Each field of a BIFS node that accepts nodes as fields can only accept a specific set of nodes. Each of these sets of nodes is stored in a node data type table and is referenced by a node data type (NDT).

A field of type SFNode is fully described by its NDT. Each node belongs to one or more NDT tables. These tables are provided in Annex H and identify the various nodes and node types they contain.

Identification of a particular node depends on the context of the NDT specified for its parent field. The node data types are listed in tables in H.2., and extended node data types in Annex H.4. For each node, the value zero (encoded with as many bits as required to encode the total number of nodes in that NDT table in Annex H.2.) is used before the actual node type to indicate that the node is of an extended node type. The value 0 in each extended NDT table is reserved for future extensions. Value one in each extended NDT table is reserved for encoding of PROTOs (see 9.3.7.2).

EXAMPLE 1 — **Anchor** is identified by the 5-bit code 0b0000.1 when the context of its parent's field is SF2DNode, whereas the 7-bit code 0b0000.001 is used when the context of its parent's field is SFWorldNode.

EXAMPLE 2 — **AcousticScene** is identified by a 3-bit code 0b010, when the context of its parent field is SF3DNode in the extended node data types in Annex H.4. Since that NDT exists in tables in Annex H.2. (where the nodes of that data type are encoded with six bits), this node is completely encoded with 9 bits as: 0b000000010.

9.3.2.3 Node Coding Tables and field indexing

The syntactic description of fields is context-dependent. For a given node, its fields are indexed using a code called a `fieldID`. This `fieldID` is not unique for each field of a node but varies according to the “mode” in which the field is referenced. There are five modes in which a field may be referenced and, thus, five types of `fieldID`. For each field of each node, the binary values of the `fieldIDs` for each mode are defined in the node coding tables.

`defID`

The `defIDs` refer to the `fieldIDs` for those fields that may have a value when nodes are declared. They refer to fields of type `exposedField` and `field`. This indexing scheme is further referred to as the “`def`” mode.

`inID`

The `inIDs` refer to the `fieldIDs` for those events and fields that can be modified from outside the node. They refer to fields of type `exposedField` and `eventIn` types. This indexing scheme is further referred to as the “`in`” mode.

`outID`

The `outIDs` refer to the `fieldIDs` for those events and fields that can be output from the node. They refer to fields of type `exposedField` and `eventOut` types. This indexing scheme is further referred to as the “`out`” mode.

`dynID`

The `dynIDs` refer to the `fieldIDs` for those fields that can be animated using the BIFS-Anim scheme. They refer to a subset of the fields designated by `inIDs`. This indexing scheme is further referred to as the “`dyn`” mode.

allID

The **allIDs** refer to all events and fields of the node. That is, there is an **allID** for each field of a node. This indexing scheme is further referred to as the “all” mode.

The length of each of the **fieldID** types for each node depends on the number of fields of that type for the given node.

EXAMPLE — The **AnimationStream** node has four fields of type **defID**. Therefore, three bits are required to code the **defIDs** for this node. The **Appearance node**, however, has just three fields of type **defID**. Therefore, two bits are sufficient to code the **defIDs** for this node.

9.3.2.4 BIFSConfig

This data structure is a global data structure referred to in every BIFS access unit. The data contained in the **BIFSConfiguration** data structure is transmitted in either **BIFSConfig** or **BIFSV2Config** (see 9.3.5.2 and 9.3.5.3).

```
class BIFSConfiguration{
    int nodeIDbits;           The number of bits used to encode the nodeIDs.
    int routeIDbit;          The number of bits used to encode the routeIDs.
    int PROTOIDbits;         The number of bits used to encode the PROTO. This value is in used only
                            if the data for the structure was transmitted by BIFSV2Config
    boolean randomAccess;    The randomAccess boolean is set in the BIFSConfig to distinguish
                            between BIFS-Anim elementary streams in which support random access
                            at any intra frame, and those where random access may not be possible
                            at all intra frames. In the latter case, greater compression efficiency may
                            be achieved because a given intra frame may re-use quantization settings
                            and statistics from the previous intra frame.
    AnimationMask animMask;  The AnimationMask used for BIFS-Anim
}
```

9.3.2.5 AnimationMask

The **AnimationMask** structure contains all the relevant information to describe a BIFS-Anim session. It is constructed, upon receipt of the **BIFSConfig** or **BIFSV2Config** syntax element, during the configuration of the BIFS decoder, and updated for every received **AnimationFrame**.

```
class AnimationMask {
    int numNodes;             The number of nodes to be animated
    NodeData animNode[numNodes];  The array of animated nodes.
    boolean isIntra;          The status of the current frame: intra if isIntra is true,
                            predictive otherwise.
    boolean isActive[numNodes]; The mask of active animated node for the current frame.
                                If the node is not animated in the current frame, the
                                boolean shall be false.
}
```

9.3.2.6 NodeData

This data structure is built to decode the relevant information for one node. It is created from the node coding tables in Annex H. The following functions support relevant operations on this data structure:

```
NodeData MakeNode(int nodeType)
```

This function creates a **NodeData** structure from the node coding table matching the given **nodeType**.

```
NodeData GetNodeFromID (int nodeID)
```

This function returns the **NodeData** structure matching the given **nodeID**.

```
class NodeData {
    int nodeType;              The nodeType of the node.
```

```

FieldData field[];
The fields of this node whose construction is described below. This
array is indexed in "all" mode.

boolean isAnimField[];
The mask of animated fields for the entire BIFS-Anim session,
indexed in "dyn" mode. This array is only used in BIFS-Anim.

int nDEFbits;
The number of bits used for "def" field codes (the width of the
codewords in the 2nd column of the node coding tables).

int nINbits;
The number of bits used for "in" field codes (the width of the
codewords in the 3rd column of the node coding tables).

int nOUTbits;
The number of bits used for "out" field codes (the width of the
codewords in the 4th column of the node coding tables).

int numDEFfields;
The number of "def" fields available for this node.

int numDYNfields;
The number of "dyn" fields available for this node.

int in2all[];
The ids of eventIns and exposedFields in "all" mode, indexed with
the ids in "in" mode.

int def2all[];
The ids of fields and exposedFields in "all" mode, indexed with the
ids in "def" mode.

int dyn2all[];
The ids of dynamic fields in "all" mode, indexed with the ids in "dyn"
mode.

boolean useQuant;
When the NodeData is used for storing a prototype, the useQuant
states whether the quantization is applied on the PROTO or not.

boolean useAnim;
When the NodeData is used for storing a prototype, the useAnim
states whether the BIFS-Anim is applied on the PROTO or not.

NodeData proto;
In case that a node is contained in a PROTO, its NodeData
structure points to the PROTO NodeData structure in the proto field.

}

```

9.3.2.7 FieldData

This data structure is built to decode the relevant information for one field. It is created from the field's entry in the relevant node coding table (see Annex H).

```

Class FieldData {
    int fieldType;
        The type of the field (e.g., SFInt32Type). This is given by
        the "Field Type" column of the node coding table for the
        node to which it belongs.

    int quantType;
        The type of quantization used for the field. This is given by
        the "Q" column of the node coding table of the node to
        which it belongs. Types refer to Table 19 in 9.3.3.1.1.

    int animType;
        The animation method for the field. This is given by the "A"
        column of the node coding table. Types refer to animation
        type in Table 25 in 9.3.3.2.1.

    boolean useEfficientCoding;
        Set to true if the efficient coding is to be used. This value is
        FALSE by default. If there is a local
QuantizationParameter node this value is the same
        as its useEfficientCoding field.

        The following data structures are used in the quantization
        process:

    FieldCodingTable      fct;
        This field is determined from the node coding table as
        described in 9.3.2.9.

    AnimFieldQP          aqp;
        This field is only used in BIFS-Anim. It references an
        AnimFieldQP structure described in 9.3.2.10.

    QuantizationParameter lqp;
        This field points to the local QuantizationParameter

```

```

boolean isQuantized;
int nbBits;
float floatMin[];
float floatMax[];
int intMin[];

}

node.
Set to true if the corresponding field is quantized, false otherwise.
The number of bits used for the quantization of the field.
The minimum bounds for the quantization of vector fields.
These values are obtained from the FieldCodingTable
(described in 9.3.2.9) and the current
QuantizationParameter node (for BIFS-Scene) or the
animField (for BIFS-Anim).
The maximum bounds for the quantization of vector fields.
These values are obtained from the FieldCodingTable
(described in 9.3.2.9) and the current
QuantizationParameter node (for BIFS-Scene) or the
animField (for BIFS-Anim).
The minimum bounds for integers (SFInt32 and MFInt32).
These values are obtained from the FieldCodingTable
(described in 9.3.2.9) and the current
QuantizationParameter node (for BIFS-Scene) or the
animField (for BIFS-Anim).
}

```

It is assumed that the following functions are available:

```
int isSF(FieldData field)
Returns 1 if the field's fieldType corresponds to a single field and 0 otherwise.
```

```
int getNbComp(FieldData field)
Returns the number of quantized components for the field as given below:
```

Table 17 - Return values of getNbComp

| fieldType | quantType | animType | value returned |
|-----------------------|------------|----------------|----------------|
| SFFloat SFInt32 | any | 6, 7, 8 13 | 1 |
| SFVec2f SFVec3f | any 9 | 2, 12 9 | 2 |
| SFVec3f SFRotation | !=9 any | 1, 4, 11 10 | 3 |

The number of quantized components is the same as the natural number of components (three for SFVec3f, two for SFVec2f, and so on) except for normals (2) and rotations (3) because of the quantization process (see 9.3.3.3).

9.3.2.8 Node Data Type Table Parameters

The following functions provide access to the node data type tables (described in Annex H):

```
int GetNodeType(int nodeDataType, int localNodeType)
Returns the nodeType of the node indexed by localNodeType in the node data type table. The nodeType of a
node is its index in the SFWorldNode NDT Table.
```

```
int GetNDTnbBits(int nodeDataType)
Returns the number of bits used to index the nodes of the matching node data type table (this number is indicated
in the last column of the first row of the node data type table).
```

```
int GetNDTFromID(int id)
Returns the nodeDataType for the children field of the node identified by the nodeID, id. Nodes having a
children field may have restrictions on the types of node that may occupy the field. These node types are
indicated in the node semantics (see 9.4 and ISO/IEC 14772-1:1998 , Table 4.3).
```

9.3.2.9 Field Coding Table

This data structure contains parameters relating to the quantization of the field. It is created from the field's entry in the relevant node coding table (Annex H).

```
Class FieldCodingTable {
    float floatMin[ ];
    The minimum default bounds for fields of type SFFloat, SFVec2f and
    SFVec3f. These values are obtained from the “[m, M]” column of the
    node coding table.

    float floatMax[ ];
    The minimum default bounds for fields of type SFFloat, SFVec2f and
    SFVec3f. These values are obtained from the “[m, M]” column of the
    node coding table.

    float intMin[ ];
    The minimum default bounds for fields of type SFIInt32. These values
    are obtained from the “[m, M]” column of the node coding table.

    float intMax[ ];
    The minimum default bounds for fields of type SFIInt32. These values
    are obtained from the “[m, M]” column of the node coding table.

    int defaultNbBits;
    The number of bits used by default for each field. Only used when the
    quantization category of the field is 13. For quantization category 13,
    the number of bits used for coding is also specified in the node coding
    (e.g “13 16” in the node coding table means category 13 with 16 bits).

}
```

9.3.2.10 AnimFieldQP

This data structure contains the necessary quantization parameters and information for the animation of a field. It is updated throughout the BIFS-Anim session.

```
class AnimFieldQP {
    int animType;
    The animation method for the field. This is given by the “A” column of
    the node coding table for each node. Types refer to animation type in
    Table 25 in 9.3.3.2.1.

    boolean useDefault;
    If this bit is set to TRUE, then the bounds used in intra mode are those
    specified in the “[m, M]” column of the node coding table. The default
    value is FALSE.

    boolean isTotal;
    If the field is a multiple field and if this boolean is set to TRUE, all the
    components of the multiple field are animated.

    int numElement;
    The number of elements being animated in the field. This is 1 for all
    single fields, and equal to or greater than 1 for multiple fields.

    int indexList[];
    If the field is a multiple field and if isTotal is false, this is the list of
    the indices of the animated SFFields. For instance, if the field is an
    MFField with elements 3,4 and 7 being animated, the value of
    indexList will be {3,4,7}.

    float[] Imin;
    The minimum values for bounds of the field in intra mode. This value is
    obtained from the “[m, M]” column of the node coding table (if
    useDefault is TRUE), the InitialAnimQP (if useDefault is
    FALSE and the last intra did not hold any new AnimQP), or the
    AnimQP.

    float[] Imax;
    The maximum values for bounds of the field in intra mode. This value is
    obtained from the “[m, M]” column of the semantics table (if
    useDefault is TRUE), the InitialAnimQP (if useDefault is
    FALSE and if the last intra did not hold any new AnimQP), or the
    AnimQP.

    int[] IminInt;
    The minimum value for bounds of variations of integer fields in intra
    mode. This value is obtained from the InitialAnimQP (if the last
    intra did not hold any new AnimQP) or AnimQP structure.

    int[] Pmin;
    The minimum value for bounds of variations of the field in predictive
    mode. This value is obtained from the InitialAnimQP (if the last
    intra did not hold any new AnimQP) or AnimQP.

    int INNbBits;
    The number of bits used in intra mode for the field. This value is
    obtained from the InitialAnimQP or AnimQP.

    int PNbBits;
    The number of bits used in predictive mode for the field. This value is
```

obtained from the `InitialAnimQP` (if the last intra did not hold any new `AnimQP`) or `AnimQP` structure.

}

It is assumed that the following function is available :

```
int getNbBounds(AnimFieldQP aqp)
```

Returns the number of set of bounds matching the animation type (see 9.3.2.3), as follows :

Table 18 - Return values of getNbBounds

| aqp.animType | value returned |
|--------------|----------------|
| 4, 6, 7, 8 | 1 |
| 9, 10 | |
| 11, 12, 13 | |
| 2 | 2 |
| 1 | 3 |

Note that only `Position2D` and `Position3D` have specific sets of bounds for each of their components. The number of bounds is also the number of independent models used in predictive mode during the BIFS-Anim session.

9.3.3 Quantization

In BIFS scenes, the values of the fields may be quantized. BIFS-Anim data is always quantized. This subclause describes this quantization process. A number of parameters control the quantization of a field. Here, these parameters are used to construct a notational data structure called `FieldData`. In this subclause, the semantics of how to determine these parameters for BIFS scenes and BIFS-Anim are first described, followed by a description of the actual quantization process.

9.3.3.1 Quantization of BIFS scenes

9.3.3.1.1 Quantization categories

Single fields are coded according to the type of the field. The fields have a default syntax that specifies a non-quantized encoding. When quantization is used, the quantization parameters are obtained from a special node called **QuantizationParameter**. The following quantization categories are specified, providing suitable quantization procedures for the various types of quantities represented by the various fields of the BIFS nodes.

Table 19 - Quantization Categories

| Category | Description |
|-----------------|----------------------------|
| 0 | None |
| 1 | 3D position |
| 2 | 2D positions |
| 3 | Drawing order |
| 4 | SFColor |
| 5 | Texture Coordinate |
| 6 | Angle |
| 7 | Scale |
| 8 | Interpolator keys |
| 9 | Normals |
| 10 | Rotations |
| 11 | Object Size 3D (1) |
| 12 | Object Size 2D (2) |
| 13 | Linear Scalar Quantization |
| 14 | CoordIndex |
| 15 | Reserved |

Each field that may be quantized is assigned to one of the quantization categories (see Annex H). Along with quantization parameters, minimum and maximum values are specified for each field of each node.

9.3.3.1.2 Determining the quantization parameters for a given field

The scope of quantization is constrained to a single BIFS access unit. A field is quantized when:

- The field is of type SFInt32, SFFloat, SFRotation, SFVec2f or SFVec3f.
- The quantization category of the field is not 0.
- The node to which the field belongs has a **QuantizationParameter** (see 9.4.2.89) node in its context
- The quantization for this type of field is activated (by setting the corresponding boolean to TRUE in the **QuantizationParameter** node).

The `isQuantized`, `nbBits`, `floatMin`, `floatMax` and `intMin` fields of the `FieldData` structure pertain to the quantization of the field. The values of these fields are determined from the local **QuantizationParameter** (`lqp`) and the `FieldCodingTable` (`fct`) stored in the `FieldData`. This is done in the following way:

isQuantized

`isQuantized` is set to true when the three following conditions are met :

- `lqp != 0` (there is a **QuantizationParameter** node in the scope of the field)
- `quantType != 0` (the field value is of a type that may be quantized), and
- the following condition is met for the relevant quantization type:

Table 20 - Condition for setting `isQuantized` to true

| quantType | Condition |
|------------------|---|
| 1 | <code>lqp.position3DQuant == TRUE</code> |
| 2 | <code>lqp.position2DQuant == TRUE</code> |
| 3 | <code>lqp.drawOrderQuant == TRUE</code> |
| 4 | <code>lqp.colorQuant == TRUE</code> |
| 5 | <code>lqp.textureCoordinateQuant == TRUE</code> |
| 6 | <code>lqp.angleQuant == TRUE</code> |
| 7 | <code>lqp.scaleQuant == TRUE</code> |
| 8 | <code>lqp.keyQuant == TRUE</code> |
| 9 | <code>lqp.normalQuant == TRUE</code> |
| 10 | <code>lqp.normalQuant == TRUE</code> |
| 11 | <code>lqp.sizeQuant == TRUE</code> |
| 12 | <code>lqp.sizeQuant == TRUE</code> |
| 13 | Always TRUE |
| 14 | Always TRUE |
| 15 | Always TRUE |

nbBits

In the BIFS scene quantization process, `nbBits` is set in the following way :

Table 21 - Value of `nbBits` depending on `quantType`

| quantType | nbBits |
|------------------|--|
| 1 | <code>lqp.position3DNbBits</code> |
| 2 | <code>lqp.position2DNbBits</code> |
| 3 | <code>lqp.drawOrderNbBits</code> |
| 4 | <code>lqp.colorNbBits</code> |
| 5 | <code>lqp.textureCoordinateNbBits</code> |
| 6 | <code>lqp.angleNbBits</code> |
| 7 | <code>lqp.scaleNbBits</code> |
| 8 | <code>lqp.keyNbBits</code> |
| 9, 10 | <code>lqp.normalNbBits</code> |
| 11, 12 | <code>lqp.sizeNbBits</code> |
| 13 | <code>fct.defaultNbBits</code> |
| 14 | This value is set according to the number of points received in the last received coord field of the node. Let N that number, then: $\text{nbBits} = \text{Ceil}(\log_2(N))$ where the function Ceil returns the smallest integer greater than its argument |
| 15 | 0 |

floatMin[]

In the BIFS scene quantization process, `floatMin` is set in the following way:

Table 22 - Value of floatMin, depending on quantType and fieldType

| quantType | fieldType | floatMin |
|------------------|------------------|--|
| 1 | SFVec3fType | lqp.position3Dmin |
| 2 | SFVec2fType | lqp.position2Dmin |
| 3 | SFFloatType | max(fct.min[0], lqp.drawOrderMin) |
| 4 | SFFloatType | lqp.colorMin |
| | SFColorType | lqp.colorMin, lqp.colorMin, lqp.colorMin |
| 5 | SFVec2fType | lqp.textureCoordinateMin |
| 6 | SFFloatType | Max(fct.min[0], lqp.angleMin) |
| 7 | SFFloatType | lqp.scaleMin |
| | SFVec2fType | lqp.scaleMin, lqp.scaleMin |
| | SFVec3fType | lqp.scaleMin, lqp.scaleMin, lqp.scaleMin |
| 8 | SFFloatType | Max(fct.min[0], lqp.keyMin) |
| 9 | SFVec3fType | 0.0 |
| 10 | SFRotationType | 0.0 |
| 11,12 | SFFloatType | lqp.sizeMin |
| | SFVec2fType | lqp.sizeMin, lqp.sizeMin |
| | SFVec3fType | lqp.sizeMin, lqp.sizeMin, lqp.sizeMin |
| 13,14,15 | | NULL |

floatMax[]

In the BIFS scene quantization process, floatMax is set in the following way:

Table 23 - Value of floatMax, depending on quantType and fieldType

| quantType | fieldType | floatMax |
|------------------|------------------|--|
| 1 | SFVec3fType | lqp.position3Dmax |
| 2 | SFVec2fType | lqp.position2Dmax |
| 3 | SFFloatType | min(fct.max[0], lqp.drawOrderMax) |
| 4 | SFFloatType | lqp.colorMax |
| | SFColorType | lqp.colorMax, lqp.colorMax, lqp.colorMax |
| 5 | SFVec2fType | lqp.textureCoordinateMax |
| 6 | SFFloatType | min(fct.max[0], lqp.angleMax) |
| 7 | SFFloatType | lqp.scaleMax |
| | SFVec2fType | lqp.scaleMax, lqp.scaleMax |
| | SFVec3fType | lqp.scaleMax, lqp.scaleMax, lqp.scaleMax |
| 8 | SFFloatType | min(fct.max[0], lqp.keyMax) |
| 9 | SFVec3fType | 1.0 |
| 10 | SFRotationType | 1.0 |
| 11,12 | SFFloatType | lqp.sizeMax |
| | SFVec2fType | lqp.sizeMax, lqp.sizeMax |
| | SFVec3fType | lqp.sizeMax, lqp.sizeMax, lqp.sizeMax |
| 13,14,15 | | NULL |

intMin[]

In the BIFS scene quantization process, intMin is set in the following way:

Table 24 - Value of intMin, depending on quantType

| quantType | intMin |
|---|---------------|
| 1, 2, 3, 4, 5, 6, 7, 8 9, 10, 11, 12 | NULL |
| 13, 14 | fct.intMin[0] |
| 15 | NULL |

9.3.3.2 Quantization of BIFS-Anim**9.3.3.2.1 Animation Categories**

The fields are grouped in the following categories for animation:

Table 25 - Animation Categories

| Category | Description |
|-----------------|--------------------|
| 0 | None |
| 1 | Position 3D |
| 2 | Positions 2D |
| 3 | Reserved |
| 4 | Color |
| 5 | Reserved |
| 6 | Angle |
| 7 | Float |
| 8 | BoundFloat |
| 9 | Normals |
| 10 | Rotation |
| 11 | Size 3D |
| 12 | Size 2D |
| 13 | Integer |
| 14 | Reserved |
| 15 | Reserved |

9.3.3.2.2 Determining the quantization parameters for a given field

The `isQuantized`, `nbBits`, `floatMin`, `floatMax` and `intMin` fields of the `FieldData` structure pertain to the quantization of the field. The values of these fields are determined from the local `AnimFieldQP` (`aqp`) and the `FieldCodingTable` (`fct`) stored in the `FieldData`. This is done in the following way :

isQuantized

In the BIFS-Anim quantization process, `isQuantized` is always TRUE.

nbBits

In the BIFS-Anim quantization process, `nbBits` is set in the following way :

Table 26 - Value of nbBits, depending on animType

| animType | nbBits |
|---------------------------------------|-------------------------------|
| 1, 2, 4, 6, 7, 8, 9 10, 11, 12, 13 | <code>animType.INbBits</code> |

floatMin[]

In the BIFS-Anim quantization process, `floatMin` is set in the following way :

Table 27 - Value of floatMin, depending on animType

| animType | aqp.useDefault | floatMin |
|------------------------------------|-----------------------|---------------------------------------|
| 4 Color | true | fct.min[0], fct.min[0], fct.min[0] |
| | false | aqp.IMin[0], aqp.IMin[0], aqp.IMin[0] |
| 8 BoundFloat | true | fct.min[0] |
| | false | aqp.IMin[0] |
| 1 Position 3D | false | aqp.IMin |
| 2 Position 2D | false | aqp.IMin |
| 11 Size 3D | false | aqp.IMin[0], aqp.IMin[0] |
| 12 Size 2D | false | aqp.IMin[0], aqp.IMin[0], aqp.IMin[0] |
| 7 Float | false | aqp.IMin[0] |
| 6 Angle 9 Normal 10 Rotation | false | 0.0 |
| 13 Integer | false | NULL |
| 14,1 Reseved 5 | | NULL |

floatMax[]

In the BIFS-Anim quantization process, floatMax is set in the following way:

Table 28 - Value of floatMax, depending on animType

| animType | aqp.useDefault | floatMax |
|------------------------------------|-----------------------|---------------------------------------|
| 4 Color | true | fct.max[0], fct.max[0], fct.max[0] |
| | false | aqp.IMax[0], aqp.IMax[0], aqp.IMax[0] |
| 8 BoundFloat | true | fct.max[0] |
| | false | aqp.IMax[0] |
| 1 Position 3D | false | aqp.IMax |
| 2 Position 2D | false | aqp.IMax |
| 11 Size 3D | false | aqp.IMax[0], aqp.IMax[0] |
| 12 Size 2D | false | aqp.IMax[0], aqp.IMax[0], aqp.IMax[0] |
| 7 Float | false | aqp.IMax[0] |
| 6 Angle 9 Normal 10 Rotation | false | 2*Pi |
| 13 Integer | false | 1.0 |
| 14,1 Reseved 5 | | NULL |

intMin[]

In the BIFS-Anim quantization process, intMax is set in the following way:

Table 29 - Value of intMin, depending on animType

| animType | intMin |
|-----------------------------------|----------------|
| 1, 2, 4, 6, 7, 8 9, 10, 11, 12 | NULL |
| 13 | aqp.IminInt[0] |
| 14, 15 | NULL |

9.3.3.3 Quantization process

Let $v_q(t)$ be the value decoded from the bitstream at an instant t . Then, the inverse-quantized value at time t is:

$$v(t) = \text{InvQuant}(v_q(t))$$

The linear quantization and inverse quantization are:

```
int quantize (float Vmin, float Vmax, float v, int Nb)
```

which returns $v_q = \frac{v - V_{\min}}{V_{\max} - V_{\min}}(2^{Nb} - 1)$

```
float invQuantize (float Vmin, float Vmax, int vq, int Nb)
```

which returns $\hat{v} = V_{\min} + v_q \frac{V_{\max} - V_{\min}}{2^{\max(Nb, l)} - 1}$

If `isQuantized` is true, the quantization/inverse quantization process is the following :

Table 30 - Quantization and inverse quantization process

| QuantType | animType | Quantization/Inverse Quantization Process |
|-----------------------------|-------------------------|--|
| 1,2,3,4,5 6,7,8 11,12 | 1,2,4 6,7,8 11,12 | For each component of the vector, the float quantization is applied: $v_q[i] = \text{quantize}(\text{floatMin}[i], \text{floatMax}[i], v[i], \text{nbBits})$ For the inverse quantization: $\hat{v}[i] = \text{invQuantize}(\text{floatMin}[i], \text{floatMax}[i], v_q[i], \text{nbBits})$ |
| 9,10 | 9,10 | For normals and rotations, the quantization method is as follows. Normals are first renormalized : $v[0] = \frac{n_x}{\sqrt{n_x^2 + n_u^2 + n_z^2}}, \quad v[1] = \frac{n_y}{\sqrt{n_x^2 + n_u^2 + n_z^2}}, \quad v[2] = \frac{n_z}{\sqrt{n_x^2 + n_u^2 + n_z^2}}$ Rotations (axis \vec{n} , angle α) are first written as quaternions : $v[0] = \cos(\frac{\alpha}{2}) \quad v[1] = \frac{n_x}{\ \vec{n}\ } \cdot \sin(\frac{\alpha}{2}) \quad v[2] = \frac{n_y}{\ \vec{n}\ } \cdot \sin(\frac{\alpha}{2}) \quad v[3] = \frac{n_z}{\ \vec{n}\ } \cdot \sin(\frac{\alpha}{2})$ The number of reduced components is defined to be N: 2 for normals, and 3 for rotations. Note that v is then of dimension N+1. The compression and quantization process is the same for both : |

| QuantType | animType | Quantization/Inverse Quantization Process |
|------------------|-----------------|---|
| | | <p>The orientation k of the unit vector v is determined by the largest component in absolute value: $k = \text{argMax}(v[i])$. This is an integer between 0 and N that is encoded using two bits.</p> <p>The direction of the unit vector v is 1 or -1 and is determined by the sign of the component $v[k]$. Note that this value is not written for rotations (because of the properties of quaternions).</p> <p>The N components of the compressed vector are computed by mapping the square on the unit sphere $\left\{ v \mid \frac{ v[i] }{ v[k] } \leq 1 \right\}$ into a N dimensional square :</p> $v_c[i] = \frac{4}{\pi} \tan^{-1} \left(\frac{v[(i+k+1) \bmod (N+1)]}{v[k]} \right) \quad i = 0, \dots, N$ <p>If nbBits=0, the process is complete. Otherwise, each component of v_c (which lies between -1 and 1) is quantized as a signed integer as follows :</p> $v_q[i] = 2^{\text{nbBits}-1} + \text{quantize}(\text{floatMin}[0], \text{floatMax}[0], v_c[i], \text{nbBits}-1)$ <p>The value is encoded in the bitstream as</p> $v_q[i]$ <p>The decoding process is the following :</p> <p>The value decoded from the stream is converted to a signed value</p> $v_q[i] = v_{decoded} - 2^{\text{nbBits}-1}$ <p>The inverse quantization is performed</p> $v_c[i] = \text{invQuantize}(\text{floatMin}[0], \text{floatMax}[0], v_q[i], \text{nbBits}-1)$ <p>After extracting the orientation (k) and direction (dir), the inverse mapping can be performed :</p> $\hat{v}[k] = \text{dir.} \sqrt{\frac{1}{1 + \sum_{i=0}^{i < N} \tan^2 \frac{\pi \cdot v_c[i]}{4}}}$ |

| QuantType | animType | Quantization/Inverse Quantization Process |
|-----------|----------|---|
| | | <p>$\hat{v}[(i + k + 1) \bmod(N + 1)] = \tan\left(\frac{\pi \cdot v_c[i]}{4}\right) \cdot \hat{v}[k] \quad i = 0, \dots, N$</p> <p>If the object is a rotation, v can be either used directly or converted back from a quaternion to a SFRotation :</p> $\alpha = 2 \cdot \cos^{-1}(\hat{v}[0]) \quad n_x = \frac{\hat{v}[1]}{\sin(\alpha/2)} \quad n_y = \frac{\hat{v}[2]}{\sin(\alpha/2)} \quad n_z = \frac{\hat{v}[3]}{\sin(\alpha/2)}$ <p>The entire compression process therefore consists in projecting a vector of the unit sphere onto the face of a cube inscribed inside the sphere, and transmitting separately the face's index (orientation: x, y or z – and direction : + or -) and the coordinates on the face.</p> <p>EXAMPLE — How two different normals are encoded in the case nbBits=3. The compensation process (described in 9.3.4) is also illustrated.</p> <p>Note that two quaternions that lie in opposite directions on the unit sphere actually represent the same rotation. This is the reason why the direction is not coded for rotations.</p> |

| QuantType | animType | Quantization/Inverse Quantization Process |
|----------------------|-----------------|---|
| 13,14 | 13 | <p>For integers, the quantized value is the integer shifted to fit the interval $[0, 2^{\text{nbBits}} - 1]$.</p> $v_q = v - \text{intMin}$ <p>The inverse quantization process is then :</p> $\hat{v} = \text{intMin} + v_q$ |
| fieldType SFImage | | <p>For SFImage types, the width and height of the image are sent. numComponents defines the image type. The following four types are enabled:</p> <ul style="list-style-type: none"> If the value is '00', then a grey scale image is defined. If the value is '01', a grey scale with alpha channel is used. If the value is '10', then an RGB image is used. If the value is '11', then an RGB image with alpha channel is used. |

9.3.4 Compensation process

This subclause describes the mechanism used to compensate a quantized value for a given FieldData structure. In other words, how to add a delta to a quantized value to yield the result of addition, which is another quantized value. For vectorial types, this is simply an addition component by component, but for normals and rotations special care has to be taken when performing this addition. This process is used in predictive mode in BIFS-Anim sessions.

Let v_q^1 be the initial quantized value, v^δ be the delta value and v_q^2 be the quantized value resulting from the addition. The general inverse compensation process is :

$$v_q^2 = \text{AddDelta}(v_q^1, v^\delta)$$

v_q^1 and v^δ are interpreted as follows:

A quantized value v_q contains an array of integers $vq[]$. Additionally, for normals and rotations, v_q^1 contains an orientation and, for normals only, a direction (see 9.3.3.3).

A delta value v^δ contains an array of integers $vDelta[]$. Additionnally, for normals, it contains an integer inverse whose value is -1 or 1.

The size of these arrays is that returned by the function `getNbComp(field)`, as described in 0.

The result v_q^2 is then computed in the following way :

Table 31 - Compensation process

| animType | Compensation Process | | | | | | | |
|-------------------------|---|--|-----------------------|---|----------------|---|--------------------|---|
| 1,2,4,6,7,8 11,12,13 | <p>The components of v_q^2 are: $vq2[i] = vq1[i] + vDelta[i]$</p> | | | | | | | |
| 9,10 | <p>The addition is first performed component by component and stored in a temporary array: $vqTemp[i] = vq1[i] + vDelta[i]$. Let $scale = 2^{\max(0, nbBits-1)} - 1$. Let N the number of reduced components (2 for normals, 3 for rotations) There are then three cases are to be considered:</p> | | | | | | | |
| | <p>For every index i, $vqTemp[i] \leq scale$</p> | v_q^2 is defined by, $vq2[i] = vqTemp[i]$ $orientation2 = orientation1$ $direction2 = direction1 * inverse$ | | | | | | |
| | <p>There is one and only one index k such that $vqTemp[k] > scale$</p> | v_q^2 is rescaled as if gliding on the faces of the mapping cube. Let $inv = 1$ if $vqTemp[k] \geq 0$ and -1 else Let $dOri = k+1$ The components of $vq2$ are computed as follows <table border="0"> <tr> <td>$0 \leq i < N - dOri$</td> <td>$vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$</td> </tr> <tr> <td>$i = N - dOri$</td> <td>$vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$</td> </tr> <tr> <td>$N - dOri < i < N$</td> <td>$vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$</td> </tr> </table> $orientation2 = (orientation1 + dOri) \bmod (N+1)$ $direction2 = direction1 * inverse * inv$ | $0 \leq i < N - dOri$ | $vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$ | $i = N - dOri$ | $vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$ | $N - dOri < i < N$ | $vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$ |
| $0 \leq i < N - dOri$ | $vq2[i] = inv * vqTemp[(i+dOri) \bmod N]$ | | | | | | | |
| $i = N - dOri$ | $vq2[i] = inv * 2 * scale - vqTemp[dOri-1]$ | | | | | | | |
| $N - dOri < i < N$ | $vq2[i] = inv * vqTemp[(i+dOri-1) \bmod N]$ | | | | | | | |
| | <p>There are several indices k such that $vqTemp[k] > scale$</p> | The result is undefined | | | | | | |

9.3.5 BIFS Configuration

9.3.5.1 Overview

This subclause describes the terminal configuration for the BIFS elementary stream. It is encapsulated within the `specificInfo` fields of the general `DecoderSpecificInfo` structure (see 8.6.7), which is contained in the `DecoderConfigDescriptor` that is carried in `ES_Descriptors`. If the session is a BIFS-Anim session, the BIFS configuration contains some specific information to describe the animation mask, which specifies the elements of the scene to be animated.

The terminal configuration is defined differently for elementary streams compliant only with this part of ISO/IEC 14496-1 and those compliant with this specification, and it is presented in 9.3.5.2 and 9.3.5.3, respectively. The

BIFS version of a specific scene description stream is determined by the objectTypeIndication field of the DecoderConfigDescriptor contained in the *ES_Descriptor* that describes this stream.

9.3.5.2 BIFSConfig

9.3.5.2.1 Syntax

```
class BIFSConfig extends DecoderSpecificInfo : bit(8) tag=DecSpecificInfoTag {
    unsigned int(5) nodeIDbits;
    unsigned int(5) routeIDbits;
    bit(1) isCommandStream;
    if(isCommandStream) {
        bit(1) pixelMetric;
        bit(1) hasSize;
        if(hasSize) {
            unsigned int(16) pixelWidth;
            unsigned int(16) pixelHeight;
        }
    }
    else {
        bit(1) randomAccess;
        AnimationMask animMask();
    }
}
```

9.3.5.2.2 Semantics

BIFSConfig is the terminal configuration for the BIFS elementary stream. It is encapsulated within the *specificInfo* fields of the general *DecoderSpecificInfo* structure (see 8.6.7), which is contained in the *DecoderConfigDescriptor* that is carried in *ES_Descriptors*.

The parameter *nodeIDbits* sets the number of bits used to represent *nodeIDs*. Similarly, *routeIDbits* sets the number of bits used to represent *ROUTEIDs*.

The boolean *isCommandStream* identifies whether the BIFS stream is a BIFS-Command stream or a BIFS-Anim stream. If the BIFS-Command stream is selected (*isCommandStream* set to TRUE), the following parameters are contained in *BIFSConfig*:

- The boolean *isPixelMetric* indicates whether pixel metrics or meter metrics are used.
- The boolean *hasSize* indicates whether a desired scene size (in pixels) is specified. If *hasSize* is set to true, *pixelWidth* and *pixelHeight* provide to the receiving terminal the desired horizontal and vertical dimensions (in pixels) of the scene.

If *isCommandStream* is false, the following information is contained in *BIFSConfig*:

- The *randomAccess* boolean signals the mode of the BIFS-Anim stream. If the bit is set to TRUE, it is possible to perform random access in the BIFS-Anim stream at any intra frame. At each intra frame, the statistics of the arithmetic decoder shall be reset. New quantization parameters shall be coded in the bistream or the default parameters sent in the BIFS-Anim mask are used. If the *randomAccess* bit is set to FALSE, compression may be more efficient, but random access may not be possible at each intra frame. See 0 for detailed semantics.
- The *AnimationMask* specifies the animation parameters of the BIFS-Anim elementary stream.

9.3.5.3. BIFSv2Config

9.3.5.3.1. Syntax

```
class BIFSv2Config {
    bit(1) use3DMeshCoding;
    bit(1) reserved;
    bit(5) nodeIDbits;
    bit(5) routeIDbits;
    bit(5) PROTOIDbits;
```

```

bit(1) isCommandStream;
if(isCommandStream) {
    bit(1) pixelMetric;
    bit(1) hasSize;
    if(hasSize) {
        int(16) pixelWidth;
        int(16) pixelHeight;
    }
}
else {
    bit(1)      randomAccess;
    AnimationMask animMask();
}
}

```

9.3.5.3.2 Semantics

BIFSV2Config is the terminal configuration for elementary streams compliant with this specification but not with this part of ISO/IEC 14496. It is not compatible with BIFSConfig defined in 9.3.5.2. It is encapsulated within the specificInfo fields of the general DecoderSpecificInfo structure (see 8.6.6), which is contained in the DecoderConfigDescriptor that is carried in ES_Descriptors.

The use3DmeshCoding flag is used to signal that the syntax of 3D Mesh as specified by ISO/IEC 14496-2:1999 is used to encode IndexedFaceSet nodes.

Parameters nodeIDbits and routeIDbits are used similarly as in BIFSConfig.

Boolean variables isCommandStream, isPixelMetric, hasSize, pixelWidth, and pixelHeight are used similarly as in BIFSConfig. If the BIFS-Command stream is selected (isCommandStream set to TRUE), a PROTOIDbits field is additionally contained in BIFSV2Config to determine the number of bits necessary to encode the PROTOs.

If isCommandStream is false, randomAccess, and AnimationMask are contained and used in BIFSV2Config similarly as in BIFSConfig.

9.3.5.4 AnimationMask

9.3.5.4.1 Syntax

```

class AnimationMask() {
    int numNodes = 0;
    do {
        ElementaryMask elemMask();
        numNodes++;
        bit(1) moreMasks;
    } while (moreMasks);
}

```

9.3.5.4.2 Semantics

The AnimationMask describes the nodes and fields to be animated, along with the quantization parameters to help decode their values. It consists of a list of ElementaryMasks.

If the boolean moreMasks is TRUE, another ElementaryMask shall be present.

9.3.5.5 Elementary mask

9.3.5.5.1 Syntax

```

class ElementaryMask() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
    NodeUpdateField node = GetNodeFromID(nodeID);
    switch (node.nodeType) {
        case FaceType:
            break;
}

```

```

        case BodyType:
        break;
        case IndexedFaceSet2DType:
        break;
        default:
            InitialFieldsMask initMask(node);
    }
}

```

9.3.5.5.2 Semantics

The `ElementaryMask` describes how to animate the elements of a node.

The integer `nodeID` identifies the animated node.

If the node's `nodeType` is **FDP**, **BDP** or **IndexedFaceSet2D**, no further information is expected.

If any other case, an `InitialFieldsMask` shall be present.

9.3.5.6 InitialFieldsMask

9.3.5.6.1 Syntax

```

class InitialFieldsMask(NodeUpdateField node) {
    for(i=0; i<node.numDYNfields; i++)
        bit(1) node.isAnimField[i];
    int i;
    for(i=0; i<node.numDYNfields; i++) {
        if (node.isAnimField[i]) {
            FieldData field = node.field[node.dyn2all[i]];
            AnimFieldQP aqp = field.aqp;
            if (!isSF(field)) {
                bit(1) aqp.isTotal;
                if (!aqp.isTotal) {
                    unsigned int(5) nbBits;
                    do {
                        int(nbBits) aqp.indexList[aqp.numElement++];
                        bit(1) moreIndices;
                    } while (moreIndices);
                }
                InitialAnimQP QP[i](field.aqp);
            }
        }
    }
}

```

9.3.5.6.2 Semantics

The `InitialFieldsMask` specifies which fields of a given node are animated.

The array of booleans `isAnimField` describes whether the fields (indexed with `dynIDs`) are animated.

If a multiple field is animated and if the boolean `isTotal` is TRUE, all the of the field's individual elements are animated.

If a multiple field is animated and if the boolean `isTotal` is FALSE, the indices of the animated individual field are sent and stored in `aqp.indexList[]`. The number of bits used to encode them is specified by `nbBits`. If the boolean `moreIndices` is TRUE, another index shall be present.

An `InitialAnimQP` shall then be expected.

9.3.5.7 InitialAnimQP

9.3.5.7.1 Syntax

```
InitialAnimQP(animFieldQP aqp) {
```

```

aqp.useDefault=FALSE;
uint(4) type;
aqp.animType = type;
switch(aqp.animType) {

    case 4:           // Color
    case 8:           // BoundFloats
        bit(1)      aqp.useDefault
    case 1:           // Position 3D
    case 2:           // Position 2D
    case 11:          // Size 3D
    case 12:          // Size 2D
    case 7:           // Floats
        if (!aqp.useDefault) {
            for (i=0;i<getNbBounds(aqp);i++) {
                bit(1)      useEfficientCoding
                GenericFloat aqp.Imin[i](useEfficientCoding);
            }
            for (i=0;i<getNbBounds(aqp);i++) {
                bit(1)      useEfficientCoding
                GenericFloat aqp.Imax[i](useEfficientCoding);
            }
        }
        break;

    case 13:          // Integers
        int(32)     aqp.IminInt[0];
        break;
}
unsigned int(5)      aqp.INbBits;

for (i=0;i<getNbBounds(aqp);i++) {
    int(INbBits+1) vq
    aqp.Pmin[i] = vq-2^aqp.INbBits;
}

unsigned int(4)      aqp.PNbBits;
}

```

9.3.5.7.2 Semantics

The InitialAnimQP specifies the field's default quantization parameters.

The quantization bounds are first coded. For animTypes that have default finite bounds (Colors, BoundFloats), the default bounds of the field coding tables data structures can optionally be used by setting aqp.useDefault to TRUE. For all other animTypes, this boolean is set to FALSE. For all vectorial animTypes (Position3D, Position2D, Size3D, Size2D, Float, BoundFloat, Color), if aqp.useDefault is FALSE, the quantization bounds aqp.Imin[] and aqp.Imax[] are coded. Depending on the value of useEfficientCoding, these bounds are coded using GenericFloat as floats of 32 bits or less. For the animTypes Angle, Normal and Rotation, no quantization bounds are coded.

The number of bits used in the quantization process, aqp.INbBits, is then coded. The quantization process (see 9.3.3.3) is used in intra mode only.

The minimal bounds used to offset the values obtained from the compensation process in predictive mode, Pmin[], are then coded. Pmins may have values in the range $-2^{INbBits}$ to $2^{INbBits}-1$. The value is coded as an unsigned integer using INbBits+1 bits and has the value $PMin+2^{INbBits}$.

The number of bits used for the predictive values, aqp.PNbBits, is then coded. The compensation process (see 9.3.4) is used in predictive mode only.

9.3.6 BIFS Command Syntax

9.3.6.1 Overview

This subclause describes the commands that can be sent to act on the scene. They allow insertion, modification, and deletion of elements of the scene (new scenes, nodes, fields). All BIFS information is encapsulated in BIFS command frames. Each frame may contain commands that perform a number of operations, such as insertion, deletion, or modification of scene nodes, their fields, or routes.

9.3.6.2 Command Frame

9.3.6.2.1 Syntax

```
class CommandFrame() {
    do {
        Command command();
        bit(1) continue;
    } while (continue);
}
```

9.3.6.2.2 Semantics

A **CommandFrame** is a collection of BIFS-Commands, and corresponds to one access unit. A sequence of commands may be sent. The boolean value **continue**, when TRUE, indicates that another command follows the current one.

9.3.6.3 Command

9.3.6.3.1 Syntax

```
class Command() {
    bit(2) code;
    switch (code) {
    case 0:
        InsertionCommand insert();
        break;
    case 1:
        DeletionCommand delete();
        break;
    case 2:
        ReplacementCommand replace();
        break;
    case 3:
        SceneReplaceCommand sceneReplace();
        break;
    }
}
```

9.3.6.3.2 Semantics

For each **Command**, the 2-bit flag, **code**, signals one of the four basic commands: insertion, deletion, replacement, and scene replacement.

9.3.6.4 Insertion Command

9.3.6.4.1 Syntax

```
class InsertionCommand() {
    bit(2) parameterType ;
    switch parameterType {
    case 0:
        NodeInsertion nodeInsert();
        break;
    case 2:
        IndexedValueInsertion idxInsert();
        break;
    case 3:
        ROUTEInsertion ROUTEInsert();
    }
}
```

```

        break ;
    }
}

```

9.3.6.4.2 Semantics

There are four basic insertion commands, signaled by the 2-bit flag parameterType.

If parameterType is 0, a NodeInsertion is expected.

If parameterType is 2, an IndexedValueInsertion is expected.

If parameterType is 3, a ROUTEInsertion is expected.

9.3.6.5 Node Insertion

9.3.6.5.1 Syntax

```

class NodeInsertion() {
    bit(BIFSConfiguration.nodeIDbits) nodeID ;
    int ndt=GetNDTFromID(nodeID);
    bit(2) insertionPosition;
    switch (insertionPosition) {
    case 0: // insertion at a specified position
        bit (8) position;
        SFNode node(ndt);
        break;

    case 2: // insertion at the beginning of the field
        SFNode node(ndt);
        break;

    case 3: // insertion at the end of the field
        SFNode node(ndt);
        break;
    }
}

```

9.3.6.5.2 Semantics

The insertion of a node may be performed on a node that has an MFNode children field. Inserting a node adds the node at the desired position in the children multiple field. The command is thus valid only if the node referred to by nodeID contains a children field of type MFNode.

A node may be inserted in the children field of a grouping node. The nodeID of this grouping node is first coded.

The NDT of the inserted node can be determined from the NDT of the children field in which the node is inserted.

The position in the children field where the node shall be inserted, insertionPosition is then coded on two bits :

- If the insertionPosition is 0, the node is inserted at a specified position coded on 8 bits.
- If the insertionPosition is 2, the node is inserted at the beginning of the field.
- If the insertionPosition is 3, the node is inserted at the end of the field.

The node is then coded.

9.3.6.6 IndexedValue Insertion

9.3.6.6.1 Syntax

```

class IndexedValueInsertion() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
    NodeUpdateField node=GetNodeFromID(nodeID);
}

```

```

int(node.nINbits) inID;
bit(2) insertionPosition;
switch (insertionPosition) {
case 0: // insertion at a specified position
    bit (16) position;
    SFField value(node.field[node.in2all[inID]]);
    break;

case 2: // insertion at the beginning of the field
    SFField value(node.field[node.in2all[inID]]);
    break;

case 3: // insertion at the end of the field
    SFField value(node.field[node.in2all[inID]]);
    break;
}
}

```

9.3.6.6.2 Semantics

The `IndexedValueInsertion` syntax allows the insertion of a new value in a multiple field at the desired position.

The `nodeID` of the node in whose field the value is to be inserted is first coded.

The field in which the value is inserted must be a multiple field type. The field is signaled with an `inID`. The `inID` is parsed using the table for the node type of the node in which the value is inserted. The node type may be determined from the `nodeID`.

The position in the `children` field where the node shall be inserted, `insertionPosition`, is then coded:

- If the `insertionPosition` is 0, the node is inserted at a specified position coded using 16 bits.
- If the `insertionPosition` is 2, the node is inserted at the beginning of the field.
- If the `insertionPosition` is 3, the node is inserted at the end of the field.

The node is then coded.

9.3.6.7 ROUTE Insertion

9.3.6.7.1 Syntax

```

class ROUTEInsertion() {
    bit(1) isUpdatable;
    if (isUpdatable)
        bit(BIFSConfiguration.routeIDbits) routeID;

    bit(BIFSConfiguration.nodeIDbits) departureNodeID;
    NodeData nodeOUT=GetNodeFromID(departureNodeID);
    int(nodeOUT.nOUTbits) departureID;
    bit(BIFSConfiguration.nodeIDbits) arrivalNodeID;
    NodeData nodeIN=GetNodeFromID(arrivalNodeID);
    int(nodeIN.nINbits) arrivalID;
}

```

9.3.6.7.2 Semantics

The ROUTE insertion syntax permits the addition of a new ROUTE in the list of ROUTEs for the current scene.

A ROUTE is inserted in the list of ROUTEs by specifying a new ROUTE.

If the boolean `isUpdatable` is TRUE, a `routeID` is coded to allow the ROUTE to be referenced.

The `nodeID` of the route's departure, `departureNodeID`, is first coded.

The `outID` of the departure field in the departure node, `departureID`, is then coded.

The `nodeID` of the route's arrival, `arrivalNodeID`, is then coded.

The `inID` of the arrival field in the arrival node, `arrivalID`, is then coded.

9.3.6.8 Deletion Command

9.3.6.8.1 Syntax

```
class DeletionCommand() {
    bit(2) parameterType ;
    switch (parameterType) {
        case 0:
            NodeDeletion nodeDelete();
            break ;

        case 2:
            IndexedValueDeletion idxDelete();
            break ;

        case 3:
            ROUTEDeletion ROUTEDelete();
            break ;
    }
}
```

9.3.6.8.2 Semantics

There are three types of deletion commands, signalled by the 2-bit flag `parameterType`.

If `parameterType` is 0, a `NodeDeletion` is expected.

If `parameterType` is 2, an `IndexedValueDeletion` is expected.

If `parameterType` is 3, a `ROUTEDeletion` is expected.

9.3.6.9 Node Deletion

9.3.6.9.1 Syntax

```
class NodeDeletion() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
}
```

9.3.6.9.2 Semantics

The `NodeDeletion` syntax permits the deletion of a node with a specific `nodeID`. The node deletion deletes the node and all its instances, if it was referenced elsewhere in the scene with a `USE` statement.

The node deletion is signalled by the `nodeID` of the node to be deleted. When deleting a node, all fields shall also be deleted, as well as all `ROUTE`s related to the node or its fields.

9.3.6.10 IndexedValue Deletion

9.3.6.10.1 Syntax

```
class IndexedValueDeletion() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
    NodeData node=GetNodeFromID(nodeID);
    int(node.nINbits) inID;
    bit(2) deletionPosition;
    switch (deletionPosition) {
        case 0: // deletion at a specified position
            bit(16) position;
            break;
    }
}
```

```

    case 2: // deletion at the beginning of the field
        break;
    case 3: // deletion at the end of the field
        break;
    }
}

```

9.3.6.10.2 Semantics

The `IndexedValueDeletion` syntax permits the deletion of an element of a multiple value field.

The `nodeID` of the node to be deleted is first coded.

The `inID` of the field to be deleted is then coded.

The position in the `children` field from where the value shall be deleted, `deletionPosition`, is then coded:

- If the `insertionPosition` is 0, the value at specified position, coded using 16 bits, shall be deleted.
- If the `insertionPosition` is 2, the value at the beginning of the field shall be deleted.
- If the `insertionPosition` is 3, the value at the end of the field shall be deleted.

9.3.6.11 ROUTE Deletion

9.3.6.11.1 Syntax

```

class ROUTEDeletion() {
    bit(BIFSConfiguration.routeIDbits) routeID;
}

```

9.3.6.11.2 Semantics

The `ROUTEDeletion` syntax permits the deletion of a ROUTE with a given `routeID` from the list of active ROUTEs.

Deleting a ROUTE is performed by specifying its `routeID`. This is similar to the deletion of a node.

9.3.6.12 Replacement Command

9.3.6.12.1 Syntax

```

class ReplacementCommand() {
    bit(2) parameterType ;
    switch (parameterType) {
    case 0:
        NodeReplacement nodeReplace();
        break;

    case 1:
        FieldReplacement fieldReplace();
        break;

    case 2:
        IndexedValueReplacement idxReplace();
        break;

    case 3:
        ROUTEReplacement ROUTERReplace();
        break;
    }
}

```

9.3.6.12.2 Semantics

There are 4 replacement commands, signalled by the 2-bit flag `parameterType`.

If parameterType is 0, a NodeReplacement is expected.
If parameterType is 1, a FieldReplacement is expected.
If parameterType is 2, a IndexedValueReplacement is expected.
If parameterType is 3, a ROUTERReplacement is expected.

9.3.6.13 Node Replacement

9.3.6.13.1 Syntax

```
class NodeReplacement() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
    SFNode node(SFWorldNode);
}
```

9.3.6.13.2 Semantics

The NodeReplacement syntax permits the deletion of an existing node and its replacement with a new node. All ROUTEs pointing to the deleted node as well as any instances of the node created through the USE mechanism shall be deleted.

The node to be replaced is signalled by its nodeID. The new node is encoded with the SFWorldNode node data type, which is valid for all BIFS nodes, in order to avoid necessitating the NDT of the replaced node to be established.

9.3.6.14 Field Replacement

9.3.6.14.1 Syntax

```
class FieldReplacement() {
    bit(BIFSConfiguration.nodeIDbits) nodeID ;
    NodeData node = GetNodeFromID(nodeID);
    int(node.nINbits) inID;
    Field value(node.field[node.in2all[inID]]);
}
```

9.3.6.14.2 Semantics

This FieldReplacement syntax permits the modification of the value of a field of an existing node. The existing value shall be deleted and replaced with the new value.

The nodeID of the node whose field is to be modified is first coded

The inID of the field to be modified is then coded

The new field is then coded

9.3.6.15 IndexedValueReplacement

9.3.6.15.1 Syntax

```
class IndexedValueReplacement() {
    bit(BIFSConfiguration.nodeIDbits) nodeID;
    NodeData node = GetNodeFromID(nodeID);
    int(node.nINbits) inID;
    bit(2) replacementPosition;
    switch (replacementPosition) {
        case 0: // replacement at a specified position
            bit (16) position;
            SFField value(node.field[node.in2all[inID]]);
            break;
        case 2: // replacement at the beginning of the field
    }
}
```

```

SFField value(node.field[node.in2all[inID]]);
break;

case 3: // replacement at the end of the field
    SFField value(node.field[node.in2all[inID]]);
    break;
}
}

```

9.3.6.15.2 Semantics

The IndexedValueReplacement syntax permits the modification of the value of an element of a multiple field. As for any multiple field access, it is possible to replace at the beginning, the end or at a specified position in the multiple field.

The nodeID of the node whose field is to be modified is first coded.

The inID of the field whose value is to be modified is then coded.

The position in the children field where value has to be modified, replacementPosition, is then coded:

- If the insertionPosition is 0, the value at specified position, coded using 16 bits, is modified.
- If the insertionPosition is 2, the value at the beginning of the field is modified.
- If the insertionPosition is 3, the value at the end of the field is modified.

The new value is then coded as a SFField.

9.3.6.16 ROUTE Replacement

9.3.6.16.1 Syntax

```

class ROUTEReplacement() {
    bit(BIFSConfiguration.routeIDbits) routeID;
    bit(BIFSConfiguration.nodeIDbits) departureNodeID;
    NodeData nodeOUT = GetNodeFromID(nodeID);
    int(nodeOUT.nOUTbits) departureID;
    bit(BIFSConfiguration.nodeIDbits) arrivalNodeID;
    NodeData nodeIN = GetNodeFromID(nodeID);
    int(nodeIN.nINbits) arrivalID;
}

```

9.3.6.16.2 Semantics

Replacing a ROUTE deletes the replaced ROUTE and replaces it with the new ROUTE.

The routeID of the ROUTE to be replaced is first coded.

The nodeID of the new route's departure, departureNodeID, is then coded.

The outID of the departure field in the departure node, departureID, is then coded.

The nodeID of the route's arrival, arrivalNodeID, is then coded.

The inID of the arrival field in the arrival node, arrivalID, is then coded.

9.3.6.17 Scene ReplaceCommand

9.3.6.17.1 Syntax

```

class SceneReplaceCommand() {
    BIFSScene scene();
}

```

9.3.6.17.2 Semantics

Replacing a scene results in the entire BIFS scene being replaced with a new **BIFSScene** scene. When used in the context of an **Inline** node, this corresponds to replacement of the sub-scene (previously assumed to be empty). In a BIFS elementary stream, the **SceneReplacement** commands are the only random access points.

9.3.7 BIFS Scene

9.3.7.1 BIFSScene

9.3.7.1.1 Syntax

```
class BIFSScene() {
    bit(6) reserved;
    bit(1) USENAMES;
    PROTOlist protos;
    SFNode nodes(SFTopNode);
    bit(1) hasROUTES;
    if (hasROUTES) {
        ROUTEs routes();
    }
}
```

9.3.7.1.2 Semantics

The integer **reserved** may be used in future extensions. It shall be set to 0.

The **BIFSScene** structure represents the global scene. A **BIFSScene** is always associated to a **ReplaceScene** BIFS-Command message. The **BIFSScene** is structured in the following way:

The nodes of the scene are described first as an **SFNode**. The first node in the scene shall be of type **SFTopNode** (see Annex H).

A boolean value, **USENAMES**, sets a global flag that indicates whether **PROTOs**, **SFNodes**, and **ROUTES** store their field names and IDs as strings, as well as integer values. (This is needed for MPEG-J and Scripts, which refer to fields, by their explicit string name).

A list of **PROTOs** associated with the scene is stored in **protos**.

ROUTES are described after all nodes

All BIFS scenes shall begin with a node of type **SFTopNode**. This implies that the top node may be one of **Layer2D**, **OrderedGroup**, **Group** or **Layer3D**.

9.3.7.2 Encoding of PROTOs

This subclause describes how **PROTOs**, a mechanism that allow scene components to be reused, are encoded. The encoding of **PROTOs** allows specification of quantization and animation categories for the **PROTO** parameters, so that **PROTOs** can take advantage of BIFS compression capabilities just like any other (predefined) node in the node coding tables. A **PROTOList** is stored in a **BIFSScene** and contains a list of **PROTOs** that are associated with that scene.

9.3.7.2.1 PROTOlist

9.3.7.2.1.1 Syntax

```
class PROTOlist() {
    bit(1) morePROTOs;
    while (morePROTOs) {
        PROTOdeclaration() proto;
        bit(1) morePROTOs;
    }
}
```

9.3.7.2.1.2 Semantics

The PROTOlist stores a list of PROTOs. A one-bit flag morePROTOS signals the fact that more PROTOs are being declared.

9.3.7.2.2 PROTOdeclaration

9.3.7.2.2.1 Syntax

```
PROTOdeclaration() {
    PROTOinterfaceDefintion interface;
    NodeData protoData = MakePROTOdata(interface);
    PROTOcode code(protoData);
    PROTOcodingTable table(protoData);
}
```

9.3.7.2.2.2 Semantics

The PROTO declaration is made of the PROTOinterface defintion, the PROTO implementation in terms of nodes, and the PROTO coding table. The PROTO coding table codes the equivalent of the Node Coding table for the PROTO. This makes it possible to animate, quantize and update the PROTO instantiations using the identical mechanisms used for the pre-defined nodes.

9.3.7.2.3 PROTOinterfaceDefinition

9.3.7.2.3.1 Syntax

```
class PROTOinterfaceDefinition {
    bit(idBits) id;
    if (USENAMES) {
        String PROTOName;
    }
    bit(1) moreFields;
    while (moreFields) {
        bit(2) eventType;
        bit(6) fieldType;
        if (USENAMES) {
            String fieldName;
        }
        if ((eventType == 0b00) || (eventType == 0b01)) {
            fieldData = makeFieldData(fieldType,eventType,isSF);
            Field(fieldData) defaultValue;
        }
        bit(1) moreFields;
    }
}
```

9.3.7.2.3.2 Semantics

An id is given to the PROTO in order to be able to refer to it. The protoIDbits is obtained from the BIFSConfiguration and encodes the ID of the PROTO in the PROTO table. The PROTO interface contains a one bit moreFields field that specifies if more PROTO fields are encoded. Then for each field, the event type (exposedField, field, eventIn, eventOut) and the fieldType is given (SFBool, SFFloat, et). The eventType is coded using 2 bits according to Table 32. The fieldType is coded using 6 bits according to Table 32. When the field type is a node, it is coded as an SFWorldNode or MFWorldNode. The USENAMES is a static constant set at the BIFSScene level, which selects the fact that node and field names are encoded as Strings as well as IDs.

Table 32 - Field and EventTypes.

| | |
|--------------|------|
| Field | 0b00 |
| exposedField | 0b01 |
| eventIn | 0b10 |
| eventOut | 0b11 |

9.3.7.2.4 PROTOcode**9.3.7.2.4.1 Syntax**

```
class PROTOcode(NodeData protoData) {
    bit(1) reserved;
    PROTolist subProtos;
    do {
        SFNode node(SFWorldNodeType,protoData);
        bit(1) moreNodes;
    } while (moreNodes);
    bit(1) hasROUTES;
    if (hasROUTES) {
        ROUTEs routes();
    }
}
```

9.3.7.2.4.2 Semantics

The bit `reserved` is reserved for future extension. The bit shall be set to 0.

First a flag signals whether the prototype is a PROTO, which then has its code included in the proto. The `PROTOcode` contains a (possibly empty) list of the sub-PROTOS of this PROTO in `subProtos`, followed by the code to execute the PROTO. The code is specified as a set of `SFNodes`, using a standard `SFNode` definition with the additional possibility to declare an `IS` field. Moreover, the PROTO body may contain `ROUTES` if the `hasROUTE` flag is set to 1.

9.3.7.2.5 PROTOCodingTable**9.3.7.2.5.1 Syntax**

```
PROTOCodingTable(NodeData protoData) {
    InterfaceCodingMask mask(protoData);
    InterfaceCodingParameters icp(protoData);
}
```

9.3.7.2.5.2 Semantics

The PROTO coding table defines the Quant and Anim parameters and the parameters necessary to reconstruct a NCT table for the PROTO definition.

9.3.7.2.6 InterfaceCodingMask**9.3.7.2.6.1 Syntax**

```
InterfaceCodingMask(NodeData protoData) {
    bit(1) protoData.useQuant;
    bit(1) protoData.useAnim;
}
```

9.3.7.2.6.2 Semantics

The mask encodes two Boolean values to store whether the PROTO can further be animated (using BIFS-Anim), or quantized.

9.3.7.2.7 InterfaceCodingParameters

9.3.7.2.7.1 Syntax

```
InterfaceCodingParameters(InterfaceCodingMask mask, NodeData protoData) {
    for (int i =0; i < protoData.numALLfields ; i++) {
        if (protoData.useQuant) {
            if (protoData.field[i].isDEF()) {
                bit(4) quantCategory;
                if (quantCategory == 13)
                    bit(5) nbBits;
                bit(1) hasMinMax;
                if (hasMinMax) {
                    CastToSF(Field) minValue(protoData.field[i]);
                    CastToSF(Field) maxValue(protoData.field[i]));
                }
            }
        }
        if (protoData.useAnim) {
            if (protoData.field[i].isIN()) {
                bit(1) isDyn;
                if (isDyn) {
                    int(4) animCategory;
                }
            }
        }
    }
}
```

9.3.7.2.7.2 Semantics

The `InterfaceCodingParameters` includes all the necessary parameters to further update, quantize and animate the PROTO instantiation.

If the `useQuant` information is TRUE, and the field is of « DEF » type, the quantization category will be encoded. If the category is 13, the number of bits for this category is further needed. To quantize, it is further necessary to encode the min and max values for the field. When the field is an SFField, the functions `CastToSF(field)` parses an SFField, but when the field is an MFField, the function `CastToSF()` parses the SFType corresponding the MFType.

If the `useAnim` is TRUE and the field type is IN, then the anim category will be encoded.

9.3.7.3 SFNode

9.3.7.3.1 Syntax

```
class SFNode(int nodeDataType) {
    bit(1) isReused;
    if (isReused) {
        bit(BIFSConfiguration.nodeIDbits) nodeID;
    }
    else {
        bit(GetNDTnbBits(nodeDataType)) localNodeType;
        nodeType = GetNodeType(nodeDataType,localNodeType);
        if ((nodeType == IndexedFaceSetType) &&
            (BIFSConfiguration.use3DmeshCoding == 1)) {
            bit(1) isUpdateable;
            if (isUpdateable) {
                bit(BIFSConfiguration.nodeIDbits) nodeID;
                if (USENAMES) {
                    String name;
                }
            }
        }
    }
}
```

```

        Mesh3D mnode;
    }
    else {
        if (localNodeType == 0) {
            bit(GetNDTnbBitsExt(nodeDataType)) extLocalNodeType;
            if (extLocalNodeType == 1) {
                bit(BIFSConfiguration.PROTOIDbits) PROTONodeType;
                nodeType = GetPROTONodeType(PROTODataType, PROTONodeType)
            }
            if (extLocalNodeType > 1) {
                nodeType = GetExtNodeType(NodeDataType, extLocalNodeType)
            }
        }
        bit(1) isUpdateable;
        if (isUpdateable) {
            bit(BIFSConfiguration.nodeIDbits) nodeID;
            if (USENAMES) {
                String name;
            }
        }
        bit(1) MaskAccess;
        if (MaskAccess) {
            MaskNodeDescription mnode(MakeNode(nodeDataType, nodeType));
        }
        else {
            ListNodeDescription lnode(MakeNode(nodeDataType, nodeType));
        }
    }
}

```

9.3.7.3.2 Semantics

The SFNode syntax represents a generic node. The encoding depends on the context of the parent field of the node. This context is described by the parent field's node data type (NDT).

If isReused is TRUE then this node is a reference to another node, identified by its nodeID. This is equivalent to the use of the USE statement in ISO/IEC 14772-1:1998.

If isReused is FALSE, then a complete node is provided in the bitstream. This requires that the nodeType be inferred from the node data type. The node is referenced by its localNodeType in the node data type table. Then, this information is converted into the node's nodeType (e.g. its localNodeType in the SFWorldNode NDT table).

If a node is detected as an IndexedFaceSet node and the Mesh3D syntax is used (see 9.4.2.56), then the IndexedFaceSet node is coded as a specific visual object (see ISO/IEC 14496-2:1999).

If the node is not an IndexedFaceSet, the localNodeType is checked. If it is 0, then an extra extLocalNodeType is resolved, corresponding to the list of extended node types for this Node Data Type.

If this extLocalNodeType is equal to 1, this indicates that the NodeType is a PROTO. Then, the global node type is constructed according to the list of PROTOs declared and their ID.

When a PROTO is declared, a new node type is created and added to the global node type table of supported nodes. The function GetPROTONodeType(PROTONodeType) returns the ID for the extended global node type of a given PROTO given its PROTO type.

The function, GetExtNodeType(NodeDataType, extLocalNodeType) is used when a node is of extended node type, in which case the NodeDataType and extended local node type allow reconstruction of the extended global node type, i.e. the position of the node in the SFWorldNode extended table.

If the extLocalType is greater than 1 (0 is reserved), then the global node type is resolved using the Node Type for extended nodes.

The isUpdatable flag enables the assignment of a nodeID to the node. This is equivalent to the DEF statement of ISO/IEC 14772-1:1998.

The node definition follows using either a `MaskNodeDescription`, or a `ListNodeDescription`.

The `nodeType` is a number that represents the type of the node. This `nodeType` is coded using a variable number of bits for efficiency reasons. The exact type of node may be determined from the `nodeType` as follows:

1. The data type of the field parsed indicates the node data type. The root node is always of type `SFTopNode`.
2. From the node data type expected and the total number of nodes type in the category, the number of bits representing the `nodeType` is obtained (this number is given in the node data type tables in Annex H).
3. The `nodeType` gives the nature of the node to be parsed.

EXAMPLE — The **Shape** node has 2 fields defined as:

| | | |
|--|-------------------------|-------------------|
| <code>exposedField SFAppearanceNode</code> | <code>Appearance</code> | <code>NULL</code> |
| <code>exposedField SFGeometry3DNode</code> | <code>geometry</code> | <code>NULL</code> |

When decoding a **Shape** node, if the first field is transmitted, a node of type `SFAppearanceNode` is expected. The only node with `SFAppearanceNode` type is the **Appearance** node, and hence the `nodeType` can be coded using 0 bits. When decoding the **Appearance** node, the following fields can be found:

| | | |
|--|-------------------------------|-------------------|
| <code>exposedField SFMaterialNode</code> | <code>Material</code> | <code>NULL</code> |
| <code>exposedField SFTextureNode</code> | <code>texture</code> | <code>NULL</code> |
| <code>exposedField SFTextureTransformNode</code> | <code>TextureTransform</code> | <code>NULL</code> |

9.3.7.4 MaskNodeDescription

9.3.7.4.1 Syntax

```
class MaskNodeDescription(NodeData node) {
    if (node.protoData != null) {
        for (i=0; i<node.numALLfields; i++) {
            bit(1) Mask;
            if (Mask) {
                bit(1) isedField;
                if (isedField) {
                    unsigned int(node.proto.nALLbits) protoField;
                } else {
                    Field value(node.field[i]);
                }
            }
        }
    } else { //regular list of fields - not from a PROTO
        for (i=0; i<node.numDEFfields; i++) {
            bit(1) Mask;
            if (Mask) {
                Field value(node.field[node.def2all[i]]);
            }
        }
    }
}
```

9.3.7.4.2 Semantics

If the encoded node is a PROTO then all the fields are scanned. Those that have a `Mask` value of 1 either have a value read in or are ISed fields indicated by `isedField`. The ISed fields read a reference to the PROTO interface field to which they refer.

If the encoded node is not a PROTO, then in the `MaskNodeDescription`, a mask indicates, for each “def” mode field (those having a `defID`) of this node type, if the field value is specified. Fields are sent in the order indicated in Annex H. The field types are thus known and permit the field’s value to be decoded.

9.3.7.5 ListNodeDescription

9.3.7.5.1 Syntax

```
class ListNodeDescription (NodeData node) {
    bit(1) endFlag;
    while (!EndFlag){
        if (node.protoData != null ) {
            bit(1) isedField;
            if (isedField){
                bit(node.nALLbits) fieldRef;
                bit(node.proto.nALLbits) protoField;
            } else {
                bit(node.nDEFbits) fieldRef;
                Field value(node.field[node.def2all[fieldRef]]);
            }
        }
        else {
            bit(node.nDEFbits) fieldRef;
            Field value(node.field[node.def2all[fieldRef]]);
        }
        bit(1) endFlag;
    }
}
```

9.3.7.5.2 Semantics

In the `ListNodeDescription`, fields are directly addressed by their field reference, `fieldRef`. The reference is sent as a `defID` and its parsing depends on the node type (see 9.3.2.3). When the fields belong to a PROTO, they may be `ISed` fields, indicated by `isedField`. In this case, a reference to the PROTO interface is coded in `protoField`. Since all fields may be `ISed`, PROTO field references are encoded using `node.nALLbits`, whereas normal node field references are encoded using only `node.nDEFbits`. PROTO fields that are not `ISed` may have a default value assigned to them.

Non-PROTO fields always have a default value coded.

9.3.7.6 Field

9.3.7.6.1 Syntax

```
class Field(FieldData field) {
    if (isSF(field))
        SFField svalue(field);
    else
        MFField mvalue(field);
}
```

9.3.7.6.2 Semantics

A field is encoded according to its type: single (`SFField`) or multiple (`MFField`). A multiple field is a collection of single fields.

9.3.7.7 MFField

9.3.7.7.1 Syntax

```
class MFField(FieldData field)  {
    bit(1) reserved;
    if (!reserved) {
        bit(1) isListDescription;
        if (isListDescription)
            MFListDescription lfield(field);
        else
            MFVectorDescription vfield(field);
    }
}
```

9.3.7.7.2 Semantics

The bit reserved is reserved for future extension. The bit shall be set to 0.

MFField types can be encoded with a list (MFListDescription) or vector (MFVectorDescription) description.

9.3.7.8 MFListDescription

9.3.7.8.1 Syntax

```
class MFListDescription(FieldData field) {
    bit(1) endFlag;
    while (!endFlag) {
        SFField field(field);
        bit(1) endFlag;
    }
}
```

9.3.7.8.2 Semantics

The MFField type is encoded as a list of single fields.

9.3.7.9 MFVectorDescription

9.3.7.9.1 Syntax

```
class MFVectorDescription(FieldData field) {
    int(5) NbBits;
    int(NbBits) numberOfFields;
    SFField field[numberOfFields](field);
}
```

9.3.7.9.2 Semantics

The MFField type is encoded as a vector of fields whose dimension is specified.

The number of bits, NbBits, used to specify the dimension of the vector is first coded. The actual dimension is then coded as an unsigned integer using NbBits. The fields are then coded in order.

9.3.7.10 SFField

9.3.7.10.1 Syntax

```
class SFField(FieldData field) {
    switch (field.fieldType) {

        case SFNodeType:
            SFNode nValue(field.fieldType);
            break;

        case SFBoolType:
            SFBool bValue;
            break;

        case SFColorType:
            SFColor cValue(field);
            break;

        case SFFloatType:
            SFFloat fValue(field);
            break;

        case SFInt32Type:
            SFInt32 iValue(field);
            break;
    }
}
```

```

case SFRotationType:
    SFRotation rValue(field);
    break;

case SFStringType:
    SFString sValue;
    break;

case SFTimeType:
    SFTime tValue;
    break;

case SFUrlType:
    SFUrl uValue;
    break;

case SFVec2fType:
    SFVec2f v2Value(field);
    break;

case SFVec3fType:
    SFVec3f v3Value(field);
    break;

case SFImageType:
    SFImage imageValue(field);
    break;

case SFCommandBufferType:
    SFCommandBuffer commandValue(field);
    break;

case SFScriptType:
    SFScript scriptValue();
    break;
}
}

```

9.3.7.10.2 Semantics

Each field is encoded according to its fieldType.

9.3.7.11 GenericFloat

9.3.7.11.1 Syntax

```

class GenericFloat(boolean useEfficientCoding) {
    if (!useEfficientCoding)
        float(32) value;
    else {
        EfficientFloat value;
    }
}

```

9.3.7.11.2 Semantics

If the parameter useEfficientCoding is true, the float is coded using the EfficientFloat scheme. Otherwise, the IEEE 32 bit format for float coding is used.

9.3.7.12 EfficientFloat

9.3.7.12.1 Syntax

```

class EfficientFloat {
    unsigned int(4) mantissaLength;
    if (mantissaLength != 0) {
        int(3) exponentLength;
        int(1) mantissaSign;
        int(mantissaLength-1) mantissa;
    }
}

```

```

    if (exponentLength != 0) {
        int(1) exponentSign;
        int(exponentLength-1) exponent;
    }
}

```

9.3.7.12.2 Semantics

For floating point values it is possible to use a more economical representation than the standard 32-bit format, as specified in the `EfficientFloat` structure. This representation separately encodes the size of the exponent (base 2) and mantissa of the number.

If the `mantissaLength` is 0, the decoded value is 0 and further parameters are not coded.

If the `mantissaLength` is not 0, the `exponentLength`, `mantissaSign` and `mantissa` are coded. The `mantissa` sign is 1 when the `mantissa` is negative, otherwise it is 0.

The `mantissa` syntax element contains the actual `mantissa` with the leading 1 removed, hence only (`mantissaLength`-1) bits are needed to encode it.

If the `exponentLength` is 0 then `exponent` is not parsed, and the decoded exponent is set, by default, to 0. Otherwise, the sign is read, with `exponentSign`=1 used to denote a negative exponent. The leading 1 of the exponent is not coded, so that `exponent` can be encoded using `exponentLength`-1 bits.

The actual `mantissa` and `exponent` are, respectively, $(2^{\text{mantissaLength}-1} + \text{mantissa})$ and

$(2^{\text{exponentLength}-1} + \text{exponent})$, thus in all other cases the decoded value shall be:

$$(1 - 2 \cdot \text{mantissaSign}) \cdot (2^{\text{mantissaLength}-1} + \text{mantissa}) \cdot 2^{(1-2 \cdot \text{exponentSign}) \cdot (2^{\text{exponentLength}-1} + \text{exponent})}$$

9.3.7.13 SFBool

9.3.7.13.1 Syntax

```
class SFBool {
    bit(1) value;
}
```

9.3.7.13.2 Semantics

If `value` is 1 the decoded boolean is set to TRUE. If `value` is 0, the decoded boolean is set to FALSE.

9.3.7.14 SFColor

9.3.7.14.1 Syntax

```
class SFColor(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else {
        GenericFloat rValue(field.useEfficientCoding);
        GenericFloat gValue(field.useEfficientCoding);
        GenericFloat bValue(field.useEfficientCoding);
    }
}
```

9.3.7.14.2 Semantics

If the field's `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise each component of the `SFColor` is coded using the `GenericFloat` scheme.

9.3.7.15 SFFloat

9.3.7.15.1 Syntax

```
class SFFloat(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else
        GenericFloat value(field.useEfficientCoding);
}
```

9.3.7.15.2 Semantics

If the field's `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise the `SFFloat` is coded using the `GenericFloat` scheme.

9.3.7.16 SFInt32

9.3.7.16.1 Syntax

```
class SFInt32(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else
        int(32) value;
}
```

9.3.7.16.2 Semantics

If the field's `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise the `SFInt32` is coded as a signed value using 32 bits.

9.3.7.17 SFRotation

9.3.7.17.1 Syntax

```
class SFRotation(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else {
        GenericFloat xAxis(field.useEfficientCoding);
        GenericFloat yAxis(field.useEfficientCoding);
        GenericFloat zAxis(field.useEfficientCoding);
        GenericFloat angle(field.useEfficientCoding);
    }
}
```

9.3.7.17.2 Semantics

If the field's `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise each component of the `SFRotation` is coded independently using the `GenericFloat` scheme.

9.3.7.18 SFString

9.3.7.18.1 Syntax

```
class SFString {
    unsigned int(5) lengthBits;
    unsigned int(lengthBits) length;
    char(8) value[length];
}
```

9.3.7.18.2 Semantics

The `SFString` is coded as an array of characters whose length is first specified.

`lengthBits` is the number of bits used to encode the string length.

`length` is the length of the string coded using `lengthBits`.

All characters are coded using the UTF-8 character encoding (ISO/IEC 10646-1).

9.3.7.19 SFTime

9.3.7.19.1 Syntax

```
class SFTime {
    double(64) value;
}
```

9.3.7.19.2 Semantics

The SFTime value is coded as a 64-bit double.

9.3.7.20 SFUrl

9.3.7.20.1 Syntax

```
class SFUrl {
    bit(1) isOD;
    if (isOD)
        bit(10) ODid;
    else
        SFString urlValue;
}
```

9.3.7.20.2 Semantics

The “od:” URL scheme is used in an `url` field of a BIFS node to refer to an object descriptor. The integer immediately following the “od:” prefix identifies the ObjectDescriptorID. For example, “od:12” refers to object descriptor number 12.

If the SFUrl refers to an object descriptor, the ObjectDescriptorID is coded as a 10-bit integer. Otherwise the URL is sent as an SFString.

9.3.7.21 SFVec2f

9.3.7.21.1 Syntax

```
class SFVec2f(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else {
        GenericFloat value1;
        GenericFloat value2;
    }
}
```

9.3.7.21.2 Semantics

If the field’s `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise each component of the SFVec2f is coded using the `GenericFloat` scheme.

9.3.7.22 SFVec3f

9.3.7.22.1 Syntax

```
class SFVec3f(FieldData field) {
    if (field.isQuantized)
        QuantizedField qvalue(field);
    else {
        GenericFloat value1(field.useEfficientCoding);
```

```

        GenericFloat value2(field.useEfficientCoding);
        GenericFloat value3(field.useEfficientCoding);
    }
}

```

9.3.7.22.2 Semantics

If the field's `isQuantized` bit is TRUE, the `QuantizedField` scheme shall be used. Otherwise each component of the `SFVec3f` is coded using the `GenericFloat` scheme.

9.3.7.23 SFImage

9.3.7.23.1 Syntax

```

class SFImage {
    unsigned int(12)   width;
    unsigned int(12)   height;
    bit(2)  numComponents;
    bit(8)  pixels[(numComponents+1)*width*height];
}

```

9.3.7.23.2 Semantics

The `width` and `height` in pixels of the image are coded as 12-bit unsigned integers.

`numComponents` defines the image type. The following types are permitted:

- If the value is '00', then a grey scale image shall be decoded.
- If the value is '01', then a grey scale with alpha channel shall be decoded.
- If the value is '10', then an RGB image shall be decoded.
- If the value is '11', then an RGB image with alpha channel shall be decoded.

Pixels shall be decoded as unsigned char, 8-bit encoded pixel values.

9.3.7.24 SFCommandBuffer

9.3.7.24.1 Syntax

```

class SFCommandBuffer {
    unsigned int(5) lengthBits;
    unsigned int(lengthBits) length;
    bit(8) value[length];
}

```

9.3.7.24.2 Semantics

The `SFCommandBuffer` syntax element is coded as an array of bytes whose length is first specified.

`lengthBits` is the number of bits used to encode the buffer length.

`length` is the length of the buffer coded using `lengthBits`.

`value` is an array of bytes of length `length`. It shall contain a `CommandFrame`, padded if necessary to complete the last byte.

9.3.7.25 QuantizedField

9.3.7.25.1 Syntax

```

class QuantizedField(FieldData field) {
    switch (field.quantType) {

```

```

        case 9:
            int(1) direction
        case 10:
            int(2) orientation
        default:
            break;
    }
    for (i=0;i<getNbComp(field);i++)
        int(field.nbBits) vq[i]
}

```

9.3.7.25.2 Semantics

The value is quantized using the quantization process described in 9.3.3.

For normals, the direction and orientation values specified in the quantization process are first coded. For rotations, only the orientation value is coded.

The compressed components, `vq[i]`, of the field's value are then coded in sequence as unsigned integers using the number of bits specified in the field data structure.

9.3.7.26 SFScript

9.3.7.26.1 Syntax

```

class SFScript() {
    bit(1) isListDescription;
    if (isListDescription)
        ScriptFieldsListDescripion();
    else
        ScriptFieldsVectorDescripion();
    const bit(1) reserved=1;
    EncodedScript();
}

```

9.3.7.26.2 Semantics

The `Script` class is used to represent a **Script** node. This can be done as a list description or as a vector description, depending on the value in `isListDescription`. The script is encoded using the bitstream syntax for `EncodedScript`, given below. This bitstream is a tree representation of the BNF grammar for ECMAScript (ISO/IEC 16262). Each node determines the parse decision selected in parsing the script, and thus the resulting bitstream can be used to interpret the script directly.

9.3.7.27 ScriptFieldsListDescription

9.3.7.27.1 Syntax

```

class ScriptFieldsListDescription() {
    bit(1) endFlag; // List description of the fields
    while (!EndFlag) {
        ScriptField();
        bit(1) endFlag;
    }
}

```

9.3.7.27.2 Semantics

`ScriptFieldsListDescription` reads a list description of the fields in the **Script** node. When `endFlag` has value 1, the list has ended and no more values are read.

9.3.7.28 ScriptFieldsVectorDescription

9.3.7.28.1 Syntax

```

class ScriptFieldsVectorDescription() {
    bit(4) fieldBits; // Number of bits for number of fields
}

```

```

bit(fieldBits) numFields; // Number of fields in the script
for (i=0; i<numFields; ++i) {
    ScriptField();
}
}

```

9.3.7.28.2 Semantics

`ScriptFieldsVectorDescription` reads a value `numFields`, to determine how many fields are in the **Script** node, and these are read sequentially. The number of bits used to give the number of fields is first read as 4 bits in `fieldBits`.

9.3.7.29 ScriptField

9.3.7.29.1 Syntax

```

class ScriptField() {
    bit(2) eventType;
    bit(6) fieldType;
    String fieldName;
    if (eventType == FIELD) {
        bit(1) hasInitialValue;
        if (hasInitialValue){
            NodeData node = makeNode(ScriptNodeType);
            Field(node.field[fieldType]) value;
        }
    }
}

```

9.3.7.29.2 Semantics

The `ScriptField` contains one field for the **Script** node. The `eventType` specifies the type of field, with values 0, 1, and 2 representing fields, eventIns and eventOuts, respectively. The `fieldType` is given in Table 33. This determines the type of the field. The `fieldName` gives the name of this field; the name is used to refer to this field from within the script.

When the event is a field, it may have a default value. This presence of this value is indicated by `hasInitialValue` being 1. In this case, the field value is read using the `Field` class. In order to be able to use the `Field` class, a node of type `NodeData` is created that then has the appropriate field value for each `fieldType` (the `fieldType` index can be used to reference field structures of the appropriate type).

Table 33 - Field Types for Script fields and PROTO fields.

| fieldType value | Field type |
|-----------------|------------|
| 0bx000000 | SFBool |
| 0bx000001 | SFFloat |
| 0bx000010 | SFTime |
| 0bx000011 | SFInt32 |
| 0bx000100 | SFString |
| 0bx000101 | SFVec3f |
| 0bx000110 | FVec2f |
| 0bx000111 | SFColor |
| 0bx001000 | SFRotation |
| 0bx001001 | SFImage |
| 0bx001010 | SFNode |
| 0bx100000 | MFBool |
| 0bx100001 | MFFloat |
| 0bx100010 | MFTime |
| 0bx100011 | MFIInt32 |
| 0bx100100 | MFString |
| 0bx100101 | MFVec3f |
| 0bx100110 | MFVec2f |
| 0bx100111 | MFCColor |
| 0bx101000 | MFRotation |
| 0bx101001 | MFIImage |
| 0bx101010 | MFNode |

9.3.7.30 EncodedScript

9.3.7.30.1 Syntax

```
class EncodedScript {
    bit(1) hasFunction
    while (hasFunction) {
        Function function;
        bit(1) hasFunction
    }
}
```

9.3.7.30.2 Semantics

A script is a collection of functions, listed sequentially while `hasFunction` is TRUE.

9.3.7.31 Function

9.3.7.31.1 Syntax

```
class Function {
    Identifier identifier;
    Arguments arguments;
    StatementBlock statementBlock;
}
```

9.3.7.31.2 Semantics

Each function consists of an `identifier`, a list of `arguments`, and a `statementBlock` which contains the script statements executed when the function is called.

9.3.7.32 Arguments

9.3.7.32.1 Syntax

```
class Arguments {
    bit(1) hasArgument
```

```

while (hasArgument) {
    Identifier identifier;
    bit(1) hasArgument
}
}

```

9.3.7.32.2 Semantics

The argument list is of arbitrary length, and terminates when `hasArgument` is 0. Each argument consists of one `identifier`.

9.3.7.33 StatementBlock

9.3.7.33.1 Syntax

```

class StatementBlock {
    bit(1) isCompoundStatement
    if (isCompoundStatement) {
        bit(1) hasStatement
        while (hasStatement) {
            Statement statement;
            bit(1) hasStatement
        }
        else {
            Statement statement;
        }
    }
}

```

9.3.7.33.2 Semantics

A `StatementBlock` consists of either a `compoundStatement`, which holds several script statements, or a single statement, indicated by the value of `isCompoundStatement`. When the `statementBlock` consists of several statements, the `hasStatement` bit is used to signal either the end of the list or the existence of another statement.

9.3.7.34 Statement

9.3.7.34.1 Syntax

```

class Statement {
    bit(3) statementType
    switch statementType {
        case ifStatementType:
            IFStatement ifStatement;
            break;
        case forStatementType:
            FORStatement forStatement;
            break;
        case whileStatementType:
            WHILEStatement whileStatement;
            break;
        case returnStatementType:
            RETURNStatement returnStatement;
            break;
        case compoundExpressionType:
            CompoundExpression compoundExpression;
            break;
        case breakStatementType:
        case continueStatementType:
            break;
        case switchStatementType:
            SWITCHStatement switchStatement;
            break;
    }
}

```

9.3.7.34.2 Semantics

A Statement may consist of one of the following specific statement types:

- ifStatement
- forStatement
- whileStatement
- returnStatement
- compoundExpression
- breakStatement
- continueStatement.
- switchStatement.

These statement types are indicated by a value from 0-7, respectively, called `statementType`.

9.3.7.35 IFStatement

9.3.7.35.1 Syntax

```
class IFStatement {
    CompoundExpression compoundExpression;
    StatementBlock statementBlock;
    bit(1) hasELSEStatement
    if (hasELSEStatement) {
        StatementBlock statementBlock;
    }
}
```

9.3.7.35.2 Semantics

An IFStatement is used for conditional execution of a `statementBlock`. It consists of a `CompoundExpression` followed by a `statementBlock`. The `statementBlock` is interpreted when the `CompoundExpression` evaluates to a non-zero or non-empty value. The IFStatement has an optional additional `statementBlock` which is included when `hasElseStatement` is 1. This second, optional `compoundStatement` is interpreted when the `CompoundExpression` evaluates to a zero or empty value.

9.3.7.36 FORStatement

9.3.7.36.1 Syntax

```
class FORStatement {
    OptionalExpression optionalExpression;
    OptionalExpression optionalExpression;
    OptionalExpression optionalExpression;
    StatementBlock statementBlock;
}
```

9.3.7.36.2 Semantics

A FORStatement is used to iterate over values, stopping when a conditional expression fails. The first `optionalExpression` shall be executed when the statement is interpreted. The second `optionalExpression` shall then be evaluated, and if it returns a non-zero or non-empty value, the `statementBlock` shall be executed. The third `optionalExpression` shall then be executed. After this process shall repeat starting with the execution of the second `optionalExpression` again, the `statementBlock`, and the third `optionalExpression`.

9.3.7.37 WHILEStatement

9.3.7.37.1 Syntax

```
class WHILEStatement {
    CompoundExpression compoundExpression;
    StatementBlock statementBlock;
}
```

9.3.7.37.2 Semantics

The WHILEStatement is used to conditionally execute a statementBlock for so long as the compoundExpression evaluates to a non-zero or non-empty value.

9.3.7.38 RETURNStatement

9.3.7.38.1 Syntax

```
class RETURNStatement {
    bit(1) returnValue
    if (returnValue) {
        CompoundExpression compoundExpression;
    }
}
```

9.3.7.38.2 Semantics

The RETURNStatement is used to return a value from a function. When a function has no return value, returnValue shall be 0. Otherwise, the returned value shall be the last value evaluated for compoundExpression.

9.3.7.39 CompoundExpression

9.3.7.39.1 Syntax

```
class CompoundExpression {
    do {
        Expression expression;
        bit(1) hasExpression
    } while (hasExpression);
}
```

9.3.7.39.2 Semantics

A CompoundExpression is a list of expressions, terminated when hasExpression has value 0. The value of the compound expression shall be the value of the last evaluated expression.

9.3.7.40 SWITCHStatement

9.3.7.40.1 Syntax

```
class SWITCHStatement {
    do {
        CompoundExpression compoundExpression; // the switched value
        bit(5) numbits // number of bits for the case value
        bit(numbits) caseValue compoundExpression; #a case value
        StatementBlock statementBlock; // statements in case
        bit(1) hasMoreCases
    } while (hasMoreCases);
    bit(1) hasDefault;
    if (hasDefault) {
        StatementBlock statementBlock; // default statements in case
    }
}
```

9.3.7.40.2 Semantics

A `SWITCHStatement` is an expression that must evaluate to an integer value. It is followed by pairs of integer values in `value` stored with `numbits` bits and `StatementBlocks`. The values represent the value of a `case` statement, which are encoded repeatedly until `hasMoreCases` is 0. An optional default `StatementBlock` is then encoded.

9.3.7.41 optionalExpression

9.3.7.41.1 Syntax

```
class optionalExpression {
    bit(1) hasCompoundExpression
    if (hasCompoundExpression) {
        CompoundExpression compoundExpression;
    }
}
```

9.3.7.41.2 Semantics

An `optionalExpression` may be an empty expression, containing no executable statements, or a `compoundExpression`. This is indicated by the value of `hasCompoundExpression`.

9.3.7.42 Expression

9.3.7.42.1 Syntax

```
class Expression {
    bit(6) expressionType
    switch expressionType {
        case curvedExpressionType:           // (compoundExpression)
            CompoundExpression compoundExpression;
            break;
        case negativeExpressionType:         // -expression
        case notExpressionType:             // !expression
        case onescompExpressionType:        // ~expression
        case incrementExpressionType:       // ++expression
        case decrementExpressionType:       // --expression
        case postIncrementExpressionType:   // expression++
        case postDecrementExpressionType:   // expression--
            Expression expression;
            break;
        case conditionExpressionType:       // expression ? expression : expression
            Expression expression;
            Expression expression;
            Expression expression;
            break;
        case stringExpressionType:
            String string;
            break;
        case numberExpressionType:
            Number number;
            break;
        case variableExpressionType:
            Identifier identifier;
            break;
        case functionCallExpressionType:
        case objectConstructExpressionType:
            Identifier identifier;
            Params params;
            break;
        case objectMemberAccessExpressionType:
            Expression expression;
            Identifier identifier;
            break;
        case objectMethodCallExpressionType:
            Expression expression;
            Identifier identifier;
    }
}
```

```

    Params params;
    break;
  case arrayDereferenceExpressionType:
    Expression expression;
    CompoundExpression compoundExpression;
    break;
  default: // =, +=, -=, *=, /=, %=, &=, |=, ^=, <<=, >>=, >>>=,
    // ==, !=, <, <=, >, >=, +, -, *, /, %, &&, ||, &, |,
    // ^, <<, >>, >>>
    Expression expression;
    Expression expression;
    break;
}
}

```

9.3.7.42.2 Semantics

An expression may contain one of a number of possible executed statements, specified by the value in expressionType. These are listed below, according the value of expressionType.

curvedExpressionType=0:

The expression consists of a compoundExpression.

NegativeExpressionType=1:

An expression shall be evaluated and the value returned shall be negated.

NotExpressionType=2:

An expression shall be evaluated and its returned value shall be logically negated (empty values return non-empty, zero values return non-zero, and vice-versa).

onescompExpressionType=3:

An expression shall be evaluated numerically (string values will yield an undefined result) and the value returned shall be bitwise negated.

IncrementExpressionType=4:

An expression shall be evaluated numerically (string values will yield an undefined result) and the value returned shall incremented by 1.

DecrementExpressionType=5:

An expression shall be evaluated numerically (string values will yield an undefined result) and the value returned shall be decremented by 1.

PostIncrementExpressionType=6:

An expression shall be evaluated numerically (string values will yield an undefined result) and its returned value shall be incremented by 1. The returned value of this expression shall be the value prior to the increment being applied.

PostDecrementExpressionType=7:

An expression shall be evaluated numerically (string values will yield an undefined result) and its returned value shall be decremented by 1. The returned value of this expression shall be the value prior to the decrement being applied.

ConditionExpressionType=8:

Three expressions shall be evaluated. If the first expression returns a non-zero or non-empty value, then the returned value of this expression shall be the value of the second expression. Otherwise, the returned value of this expression shall be the value of the third expression.

stringExpressionType=9:

The expression contains a string.

NumberExpressionType=10:

The expression is a number.

VariableExpressionType=11:

The expression is a variable and shall return the value held by the variable determined by identifier.

FunctionCallExpressionType=12:

An identifier determines which function shall be evaluated. The params shall be passed to the function by value. The returned value of the expression shall be the value returned by the function in its returnStatement.

ObjectConstructExpressionType=13:

A new object shall be created (using a 'new' statement in the script) and the object shall be held in the variable determined by identifier. A list of params shall be passed to any constructors that exist for the object.

ObjectMemberAccessExpressionType=14:

A member variable of an object shall be accessed and the returned value of the expression shall be the value in this member variable. Normally, the first expression will evaluate to a node in the scene graph (which is accessed through a script variable). This means that the first expression will normally evaluate to an identifier reference. The following identifier will then refer to a field of the node.

ObjectMethodCallExpressionType=15:

A method of an object shall be evaluated. The first expression shall evaluate to an object. The following identifier shall specify a method of this object. The following params shall be passed to the method. The value of this expression shall be the value returned by the method.

ArrayDereferenceExpressionType=16:

The expression shall be an array element reference. The first expression shall evaluate to an array reference. The following compoundExpression shall evaluate to a number that shall then be used to index the array. The returned value of this expression shall be the value held in the referenced array element.

The following binary operands evaluate two expressions and return a value based on a binary operation of these two expressions. The binary operation and value of expressionType is listed below for each binary operation. Unless explicitly stated, a string value for either of the expressions will yield an undefined result.

BinaryOperand(=) = 17:

The first expression shall evaluate to an identifier which shall be assigned the value of the second expression.

BinaryOperand(+=) = 18:

The first expression shall evaluate to an identifier. If the value held by the variable is numerical, the variable value shall be incremented by the value of the second expression, which shall also evaluate to a numerical value. If the variable is a string, then its new value shall be its original value with the second expression (which shall be a string) appended.

BinaryOperand(--)= 19:

The first expression shall evaluate to an identifier whose value shall be decremented by the value of the second expression.

BinaryOperand(*=) = 20:

The first expression shall evaluate to an identifier whose value shall be set to its current value multiplied by the value of the second expression.

BinaryOperand(/=) = 21:

The first expression shall evaluate to an identifier whose value shall be set to its current value divided by the value of the second expression.

BinaryOperand(%=) = 22:

The first expression shall evaluate to an identifier whose value shall be set to its current value modulo the value of the second expression. The expressions shall both evaluate to integer values.

BinaryOperand(&=) = 23:

The first expression shall evaluate to an identifier whose value shall be set to its current value logically bitwise ANDed with the value of the second expression.

BinaryOperand(|=) = 24:

The first expression shall evaluate to an identifier whose value shall be set to its current value logically bitwise ORed with the value of the second expression.

BinaryOperand(^) = 25:

The first expression shall evaluate to an identifier whose value shall be set to its current value logically bitwise EXCLUSIVE-ORed with the value of the second expression.

BinaryOperand(<<=) = 26:

The first expression shall evaluate to an identifier whose value shall be set to its current value bitwise shifted to the left a number of bits specified by the second expression.

BinaryOperand(>>=) = 27:

The first expression shall evaluate to an identifier whose value shall be set to its current value bitwise shifted to the right a number of bits specified by the second expression.

BinaryOperand(>>>=) = 28:

The first expression shall evaluate to an identifier whose value shall be set to its current value bitwise shifted to the right (with the least significant bits looped) a number of bits specified by the second expression.

BinaryOperand(==) = 29:

This expression shall return a non-zero value when the first and second expression are identical. Otherwise, the result of this expression shall be zero.

BinaryOperand(!=) = 30:

This expression shall return a non-zero value when the first and second expression are not identical. Otherwise, the result of this expression shall be zero.

BinaryOperand(<) = 31:

This expression shall return a non-zero value when the first expression is numerically or lexicographically less than the second. Otherwise, the result of this expression shall be zero.

BinaryOperand(<=) = 32:

This expression shall return a non-zero value when the first expression is numerically or lexicographically less than or equal to the second. Otherwise, the result of this expression shall be zero.

BinaryOperand(>) = 33:

This expression shall return a non-zero value when the first expression is numerically or lexicographically greater than the second. Otherwise, the result of this expression shall be zero.

BinaryOperand(>=) = 34:

This expression shall return a non-zero value when the first expression is numerically or lexicographically greater than or equal to the second. Otherwise, the result of this expression shall be zero.

BinaryOperand(+) = 35:

This expression shall return the sum of the first and second expressions. If both expressions are strings, then the result shall be the first string concatenated with the second.

BinaryOperand(-) = 36:

This expression shall return the difference of the first and second expressions.

BinaryOperand(*) = 37:

This expression shall return the product of the first and second expressions.

BinaryOperand(/) = 38:

This expression shall returns the quotient of the first and second expressions.

BinaryOperand(%) = 39:

This expression shall return the value of the first expression modulo the second expression.

BinaryOperand(&&) = 40:

This expression shall return the logical AND of the first and second expressions.

BinaryOperand(||) = 41:

This expression shall return the logical OR of the first and second expressions.

`BinaryOperand(&) = 42:`

This expression shall return the logical bitwise AND of the first and second expressions.

`BinaryOperand(|) = 43:`

This expression shall return the logical bitwise OR of the first and second expressions.

`BinaryOperand(^) = 44:`

This expression shall return the logical bitwise XOR of the first and second expressions.

`BinaryOperand(<<) = 45:`

This expression shall return the value of the first expression shifted to the left by the number of bits specified as the value of the second expression.

`BinaryOperand(>>) = 46:`

Returns the value of the first expression shifted to the right by the number of bits specified as the value of the second expression.

`BinaryOperand(>>>) = 47:`

This expression shall return the value of the first expression shifted to the right (with the least significant bit looped to the most significant bit) by the number of bits specified as the value of the second expression.

9.3.7.43 Params

9.3.7.43.1 Syntax

```
class Params {
    bit(1) hasParam
    while(hasParam) {
        Expression expression;
        bit(1) hasParam
    }
}
```

9.3.7.43.2 Semantics

The `Params` class consists of a (possibly empty) list of expressions. The `hasParam` bit indicates either the end of the list, or the existence of another expression.

9.3.7.44 Identifier

9.3.7.44.1 Syntax

```
class Identifier {
    bit(1) received
    if (received) {
        bit(num) identifierCode // num is calculated by counting
        // number of distinguished identifiers
        // received so far
    }
    else {
        String string;
    }
}
```

9.3.7.44.2 Semantics

An `identifier` is used to identify a variable. If the `identifier` has occurred before in the script (or as a field name in the Script node), then an `identifierCode` value is sent using `num` bits. This is indicated by the `received` bit. If the `identifier` has occurred before in the script (or as a field name in the Script node), then an `identifierCode` value is sent using `num` bits. The value of `num`, that is, the number of bits needed to send the index of the `identifier` in a list of all previously occurring `identifiers`, is variable and is determined by the minimum number of bits needed to specify the length of the list of all previously occurring `identifiers`.

9.3.7.45 String

```
class String {
    bit(8) char
    while (char!=0) {
        bit(8) char
    }
}
```

9.3.7.45.2 Semantics

A String type consist of a null-terminated list of 8 bit characters.

9.3.7.46 Number

9.3.7.46.1 Syntax

```
class Number {
    bit(1) isInteger
    if (isInteger) {
        bit(5) numbits // number of bits the integer is represented
        bit(numbits) value // integer value
    }
    else {
        bit(4) floatChar // 0-9, ., E,-, END_SYMBOL
        while (floatChar!=END_SYMBOL) {
            bit(4) floatChar
        }
    }
}
```

9.3.7.46.2 Semantics

A number shall be represented as an integer, indicated by isInteger, or as a list of 4 bit characters, represending (in order) the characters 0 ,1 ,2 ,3 ,4 ,5 ,6 ,7 ,8 ,9 ,. , E,- , END-SYMBOL. The END-SYMBOL value is used to signal the end of the float value list. The list of characters shall result in a human readable float value in scientific notation.

9.3.7.47 Boolean

9.3.7.47.1 Syntax

```
class Boolean {
    bit(1) value
}
```

9.3.7.47.2 Semantics

A Boolean value is represented by a one-bit value.

9.3.7.48 ROUTEs

9.3.7.48.1 Syntax

```
class ROUTEs() {
    bit(1) ListDescription;
    if (ListDescription)
        ListROUTES lroutes();
    else
        VectorROUTES vroutes();
}
```

9.3.7.48.2 Semantics

ROUTES may be encoded with a list (ListROUTES) or vector (VectorROUTES) description.

9.3.7.49 ListROUTEs

9.3.7.49.1 Syntax

```
class ListROUTEs() {
    do {
        ROUTE route();
        bit(1) moreROUTEs;
    }
    while (moreROUTEs);
}
```

9.3.7.49.2 Semantics

The ROUTEs are coded as a list, with the moreROUTEs flag used to indicate the end of the list (when set to false).

9.3.7.50 VectorROUTEs

9.3.7.50.1 Syntax

```
class VectorROUTEs() {
    int(5) nBits;
    int(nBits) length;
    ROUTE route[length]();
}
```

9.3.7.50.2 Semantics

The ROUTEs are coded as a vector whose dimension, length, is first specified.

9.3.7.51 ROUTE

9.3.7.51.1 Syntax

```
class ROUTE() {
    bit(1) isUpdateable;
    if (isUpdateable) {
        bit(BIFSConfiguration.routeIDbits) routeID;
        if (USENAMES) {
            String routeName;
        }
    }

    bit(BIFSConfiguration.nodeIDbits) outNodeID;
    NodeData nodeOUT = GetNodeFromID(outNodeID);
    int(nodeOUT.nOUTbits) outFieldRef;
    bit(BIFSConfiguration.nodeIDbits) inNodeID;
    NodeData nodeIN = GetNodeFromID(inNodeID);
    int(nodeIN.nINbits) inFieldRef;
}
```

9.3.7.51.2 Semantics

This is the basic syntax element used to represent a ROUTE. If isUpdateable is TRUE ('1') then a routeID is sent to enable further reference to this route. Further, if the global value of USENAMES is set, a string name, used by MPEG-J to reference the ROUTE, is also sent.

The ROUTE description is then sent. The nodeID of the target node is coded, followed by the target field's outID. The nodeID of the source node is then coded, followed by the source field's inID.

9.3.8 BIFS-Anim

9.3.8.1 Overview

The BIFS-Anim session has two parts: the AnimationMask and the AnimationFrames. The AnimationMask specifies the nodes and fields to be animated. It is sent in BIFS configuration, in the object descriptor for the BIFS

elementary stream. The animation frames are sent in a separate BIFS stream. When parsing the BIFS-Anim stream, the node structure and related functions as described in Annex H are known at the receiving terminal. The decoding data structure `AnimationMask` (see 9.3.2.5) is constructed when the `AnimationMask` syntax is read, and further used in the decoding process of the BIFS-Anim frames.

`AnimationFrames` contain update information for the values of the animated fields described in the `AnimationMask`. They are the access units of the BIFS-Anim stream. An `AnimationFrame` can send information in intra or in predictive mode. In intra mode, the values are quantized and coded directly. In predictive mode, the difference between the quantized value of the current and the last transmitted value of the field are coded. The encoding is performed using an adaptative arithmetic coder described in Annex G.

The use of the adaptive arithmetic coder is as follows:

At the beginning of each predictive frame, the adaptive arithmetic coder is reset. At the end of each frame, it is flushed.

Each animated field has its own set of models. At each intra frame, if the stream has been declared in random access mode (see 9.3.5.2), the models are reset to the uniform statistics. If the stream is not in random access mode, the models are not reset unless the decoding structures (`AnimQP`) are modified.

9.3.8.2 AnimationFrame

9.3.8.2.1 Syntax

```
class AnimationFrame() {
    AnimationFrameHeader header(BIFSConfiguration.animMask);
    AnimationFrameData data(BIFSConfiguration.animMask);
}
```

9.3.8.2.2 Semantics

The `AnimationFrame` is the access unit of the BIFS-Anim stream. It contains the `AnimationFrameHeader`, which specifies timing, and specifies which nodes are animated in the list of animated nodes, and the `AnimationFrameData`, which contains the data for all nodes being animated.

9.3.8.3 AnimationFrameHeader

9.3.8.3.1 Syntax

```
class AnimationFrameHeader(AnimationMask mask) {
    bit(23)* next;
    if (next==0)
        bit(32) AnimationStartCode;

    bit(1) mask.isIntra;
    bit(1) mask.isActive[mask.numNodes];
    if (isIntra) {
        bit(1) isFrameRate;
        if (isFrameRate)
            FrameRate rate;
        bit(1) isTimeCode;
        if (isTimeCode)
            unsigned int(18) timeCode;
    }
    bit(1) hasSkipFrames;
    if (hasSkipFrames)
        SkipFrames skip;
}
```

9.3.8.3.2 Semantics

In the `AnimationFrameHeader`, a start code may be sent at each intra or predictive frame to enable resynchronization. The first 23 bits are read ahead, and stored as the integer `next`.

If next is 0 (in other words, the first 23 bits if the AnimationFrame are 0), the first 32 bits of the AnimationFrame shall be read and interpreted as a start code that precedes the AnimationFrame.

If the boolean isIntra is TRUE, the current animation frame contains intra-coded values, otherwise it is a predictive frame.

The array of booleans isActive specifies which nodes shall be animated for this frame. isActive shall contain one boolean for each node in the AnimationMask. The boolean is set to TRUE if the node is to be animated; FALSE otherwise.

In intra mode, some additional timing information is also specified. The timing information obeys the syntax of the Facial Animation specification in ISO/IEC 14496-2. Finally, it is possible to skip a number of AnimationFrames by using the FrameSkip syntax specified in ISO/IEC 14496-2.

9.3.8.4 FrameRate

9.3.8.4.1 Syntax

```
class FrameRate {
    unsigned int(8) frameRate;
    unsigned int(4) seconds;
    bit(1) frequencyOffset;
}
```

9.3.8.4.2 Semantics

frame_rate is an 8-bit unsigned integer indicating the reference frame rate of the sequence.

seconds is a 4-bit unsigned integer indicating the fractional reference frame rate. The frame rate is computed as follows:

$$\text{frame rate} = (\text{frame_rate} + \text{seconds}/16).$$

frequency_offset is a 1-bit flag which when set to '1' indicates that the frame rate uses the NTSC frequency offset of 1000/1001. This bit would typically be set when frame_rate = 24, 30 or 60, in which case the resulting frame rate would be 23.97, 29.94 or 59.97 respectively. When set to '0' no frequency offset is present, i.e. if (frequency_offset ==1), frame rate = (1000/1001) * (frame_rate + seconds/16).

9.3.8.5 SkipFrame

9.3.8.5.1 Syntax

```
class SkipFrame {
    int nFrame = 0;
    do {
        bit(4) number_of_frames_to_skip;
        nFrame = number_of_frames_to_skip + nFrame;
    } while (number_of_frames_to_skip == 0b1111);
}
```

9.3.8.5.2 Semantics

number_of_frames_to_skip is a 4-bit unsigned integer indicating the number of frames skipped. If the number_of_frames_to_skip is equal to 15 (pattern "1111") then another 4-bit word follows allowing a skip of up to 29 frames (pattern "11111110") to be specified. If the 8-bits pattern equals "11111111", then another 4-bits word shall follow and so on, and the number of frames skipped is incremented by 30. Each 4-bit pattern of '1111' increments the total number of frames to skip with 15.

9.3.8.6 AnimationFrameData

9.3.8.6.1 Syntax

```
class AnimationFrameData (AnimationMask mask) {
```

```

int i;
for (i=0; i<mask.numNodes; i++) {
    if (mask.isActive[i]) {
        NodeData node = mask.animNode[i]
        switch (node.nodeType) {
        case FaceType:
            FaceFrameData fdata;
            break;
        case BodyType:
            BodyFrameData bdata;
            break;
        case IndexedFaceSet2DType:
            Mesh2DframeData mdata;
            break;
        default
            int j;
            for(j=0; j<node.numDYNfields; j++) {
                if (node.isAnimField[j])
                    AnimationField AField(node.field[node.dyn2all[j]],mask.isIntra);
            }
        }
    }
}

```

9.3.8.6.2 Semantics

The AnimationFrameData corresponds to the field data for the nodes being animated. In the case of an **IndexedFaceSet2D**, a **Face**, or a **Body** node pointed to by the AnimationMask, the syntax used is that defined ISO/IEC 14496-2 for animation frames and not the generic BIFS-Anim syntax as defined in 9.3.8.7. In other cases, for each field declared as an animated field is the AnimationMask, the AnimationField is sent.

In predictive mode, at the beginning of the AnimationFrameData, an adaptive arithmetic coder session is initiated by resetting the adaptive arithmetic coder in the way defined by the procedure `decoder_reset()` in Annex G. Then, the animated values are sent using this adaptive arithmetic coder, using and updating their own models.

9.3.8.7 AnimationField

9.3.8.7.1 Syntax

```

class AnimationField(FieldData field, boolean isIntra) {
    AnimFieldQP aqp = field.aqp;
    if (isIntra) {
        bit(1) hasQP;
        if(hasQP) {
            AnimQP QP(aqp);
        }
        int i;
        for (i=0; i<aqp.numElements; i++)
            AnimIValue ivalue(field);
    } else {
        int i;
        for (i=0; i<aqp.numElements; i++)
            AnimPValue pvalue(field);
    }
}

```

9.3.8.7.2 Semantics

In an AnimationField, if in intra mode, a new animation quantization parameter value may be sent. The intra or predictive frame follows.

In intra mode, if `BIFSConfiguration.randomAccess` is TRUE , the field's predictive models shall then be reset to be uniform models as defined by the procedure `model_reset(PNbBits)` in Annex G. If `BIFSConfiguration.randomAccess` is FALSE, the field's models are reset only if a new `AnimQP` is received.

- If randomAccess is set to TRUE, then the InitialAnimQP shall be used until the next intra frame.
- If randomAccess is set to FALSE, then the AnimQP that was valid at the previous intra frame shall be used. In this case, no random access is possible at this particular frame.

In intra mode, if BIFSConfig.randomAccess is TRUE , the field's predictive models shall then be reset to be uniform models as defined by the procedure model_reset(PNbBits) in Annex G. If BIFSConfig.randomAccess is FALSE, the field's models are reset only if a new AnimQP is received.

The value is then sent: in intra mode, an AnimIValue is expected, in predictive mode an AnimPValue is expected.

9.3.8.8 AnimQP

9.3.8.8.1 Syntax

```

class AnimQP(AnimFieldQP aqp) {

    bit (1) IMinMax ;
    if (IMinMax) {

        aqp.useDefault=FALSE;
        switch(aqp.animType) {

            case 4: // Color
            case 8: // BoundFloats
                bit(1) aqp.useDefault
            case 1: // Position 3D
            case 2: // Position 2D
            case 11: // Size 3D
            case 12: // Size 2D
            case 7: // Floats
                if (!aqp.useDefault) {
                    for (i=0;i<getNbBounds(aqp);i++) {
                        bit(1) useEfficientCoding
                        GenericFloat aqp.Imin[i](useEfficientCoding);
                    }
                    for (i=0;i<getNbBounds(aqp);i++)
                        bit(1) useEfficientCoding
                        GenericFloat aqp.Imax[i](useEfficientCoding);
                }
            break;

            case 13: // Integers
            int(32) aqp.IminInt[0];
            break;

        }
    }

    bit (1) hasINbBits;
    if (hasINbBits)
        unsigned int(5) aqp.INbBits;

    bit (1) PMinMax ;
    if (PMinMax) {
        for (i=0;i<getNbBounds(aqp);i++) {
            int(INbBits+1) vq
            aqp.Pmin[i] = vq-2^aqp.INbBits;
        }
    }

    bit (1) hasPNbBits;
    if (hasPNbBits)
        unsigned int(4) aqp.PNbBits;

}

```

9.3.8.8.2 Semantics

The AnimQP specifies the quantization parameters that shall be used until the next intra frame is received. AnimQP is identical to InitialAnimQP (subclause 9.3.5.7) with the exception that each quantization parameter may or may not be sent.

If BIFSConfiguration.randomAccess is TRUE and if the parameter is not coded, then the parameter defined in the InitialAnimQP in the AnimationMask is used by default.

If BIFSConfiguration.randomAccess is FALSE and if the parameter is not coded, then the parameter defined in the latest AnimQP (or InitialAnimQP if this parameter was never modified) is used.

9.3.8.9 AnimIValue

9.3.8.9.1 Syntax

```
class AnimIValue(FieldData field) {
    switch (field.animType) {
        case 9: // Normal
            int(1) direction
        case 10: // Rotation
            int(2) orientation
            break;
        default:
            break;
    }
    for (j=0;j<getNbComp(field);j++)
        int(field.nbBits) vq[j];
}
```

9.3.8.9.2 Semantics

The AnimIValue represents the quantized intra value of a field. The value is coded according to the quantization process described in 9.3.3.3.

For normals the direction and orientation values specified in the quantization process are first coded. For rotations only the orientation value is coded. If the bit representing the direction is 0, the normal's direction is set to 1, if the bit is 1, the normal's direction is set to -1. The value of the orientation is coded as an unsigned integer using 2 bits.

The compressed components vq[i] of the field's value are then coded as a sequence of unsigned integers using the number of bits specified in the field data structure.

The decoding process in intra mode computes the animation values by applying the inverse quantization process.

9.3.8.10 AnimPValue

9.3.8.10.1 Syntax

```
class AnimPValue(FieldData field) {
    switch (field.animType) {
        case 9: // Normal
            int(1) inverse
            break;
        default:
            break;
    }
    for (j=0;j<getNbComp(field);j++)
        int(aacNbBits) vqDelta[j];
}
```

9.3.8.10.2 Semantics

The AnimPValue represents the difference between the previously received quantized value and the current quantized value of a field. The value is coded using the compensation process AddDelta described in 9.3.4.

The values are decoded from the adaptive arithmetic coder bitstream with the procedure `vaac=aa_decode(model)` defined in Annex G. The model is updated with the procedure `model_update(model, vaac)`.

For normals the inverse value is decoded through the adaptive arithmetic coder with a uniform, non-updated model. If the bit is 0, then `inverse` is set to 1, the bit it is 1, `inverse` is set to -1.

The compensation values `vqDelta[i]` are then decoded in sequence. Let $v_q(t-1)$ be the quantized value decoded at the previous frame and $v_{aac}(t)$ be the value decoded by the frame's adaptive arithmetic decoder at instant t with the field's models. The value a time t is obtained from the previous value as follows:

$$\begin{aligned}v_\delta(t) &= v_{aac}(t) + PMin \\v_q(t) &= \text{AddDelta}(v_q(t-1), v_\delta(t)) \\v(t) &= \text{InvQuant}(v_q(t))\end{aligned}$$

The field's models are updated each time a value is decoded through the adaptive arithmetic coder.

If the `animType` is 1 (`Position3D`) or 2 (`Position2D`), each component of the field's value is using its own model and offset `PMin[i]`. In all other cases the same model and offset `PMin[0]` is used for all the components.

`aacNbBits` is the variable number of bits needed for the adaptive arithmetic coder to decode the symbol (see Annex G).

9.4 Node Semantics

9.4.1 Overview

The BIFS nodes include nodes that have been defined in ISO/IEC 14772-1:1998. For these nodes, the semantic information is given by normative reference with any restrictions defined herein.

9.4.2 Node specifications

9.4.2.1. AcousticMaterial

9.4.2.1.1. Node interface

AcousticMaterial {

| | | | |
|--------------|---------|-------------------------|---------------|
| field | SFFloat | reffunc | 0 |
| field | SFFloat | transfunc | 1 |
| field | MFFloat | refFrequency | [] |
| field | MFFloat | transFrequency | [] |
| exposedField | SFFloat | ambientIntensity | 0.2 |
| exposedField | SFColor | diffuseColor | 0.8, 0.8, 0.8 |
| exposedField | SFColor | emissiveColor | 0, 0, 0 |
| exposedField | SFFloat | shininess | 0.2 |
| exposedField | SFColor | specularColor | 0, 0, 0 |
| exposedField | SFFloat | transparency | 0 |

}

NOTE - For the binary encoding of this node see Annex H.3.1.

9.4.2.1.2. Functionality and semantics

The **AcousticMaterial** node is used for attaching acoustic and visual properties to surfaces (planar polygons) defined by an **IndexedFaceSet** node that is a sibling or exist in a sub-graph of a sibling of an **AcousticScene** node. The fields of this node define the visual appearance properties, as well as sound reflection and transmission properties of the **IndexedFaceSet** surfaces it is attached to. It is used in the material field of an **Appearance** node that is attached to a **Shape** node under which the **IndexedFaceSet** is defined. Each polygon in an

IndexedFaceSet that **AcousticMaterial** is associated with can produce a single specular reflection to sound whenever a corresponding sound image source is visible to the listening point (**Viewpoint** or **ListeningPoint**), or obstruct sound transmission when it appears between the sound source and the listener. Note that these reflectivity and sound transmission properties of a surface are only applied to sounds that are attached to a 3-D scene with a **DirectiveSound** node. The delay of a reflection (a predelay that is added to sound) is computed from the relative distance between the image source corresponding to the reflection, and the speed of sound which is given as a field in the **DirectiveSound** node (see 9.4.2.39).

There are two different ways of defining the reflectivity and transmission properties of **AcousticMaterial**:

The **reffunc** and **refFrequency** fields specify the sound reflectivity of the material. If **refFrequency** is an empty vector, **reffunc** is a system function representation of a linear, time-invariant system, the reflectivity transfer function of a digital filter for that material. Generally, a system function $H(z)$ is represented in the z -domain as a division of the z -transform of the output sequence $Y(z)$ with the z -transform of the input sequence $X(z)$:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^M b_k z^{-k}}{1 + \sum_{k=1}^N a_k z^{-k}}$$

The reflection function is given as digital filter coefficients in the following order:

[$b_0 b_1 b_2 \dots a_1 a_2 \dots$]

Thus, a simple scalar value b_0 can be given to a material for frequency-independent reflectivity of a surface. On the other hand, complex reflection functions can also be represented using this formulation. For example, if the **reffunc** field is 1, the amplitude of the reflection of sound off a surface will be the same as that of the incident sound, and if the field is set to 0, no sound will reflect off that surface. The default value of this field is 0, implying no reflectivity.

If **refFrequency** is different from an empty vector, the semantics of the **reffunc** is different than described above. In this case **refFrequency** specifies a set of frequencies (in Hz) at which the gains in **reffunc** field are valid; The filter applied to sound when it is reflected off this surface implements a frequency magnitude response where at the given frequencies (in **refFrequency** field) the gains in **reffunc** field are valid. An example of **refFrequency** field is:

[250 1000 2000 4000],

and an example of **reffunc** in this approach is:

[0.75 0.9 0.9 0.2]

The **transfunc** and **transFrequency** fields specify the transmission properties of the material, e.g., the filtering that is applied to sound when it passes through an **IndexedFaceSet** surface this **AcousticMaterial** is attached to, when the **IndexedFaceSet** surface appears on the direct path between the sound source and the listener. The transmission function is given similarly as in the reflectivity in **reffunc** and **refFrequency** fields with two different ways of expressing the filtering.

The fields **ambientIntensity**, **diffuseColor**, **emissiveColor**, and **shininess** are used for the visual appearance rendering similarly as in the **Material** node.

9.4.2.2. AcousticScene

9.4.2.2.1. Node interface

| | | | |
|------------------------|---------|--------------------|----------|
| AcousticScene { | | | |
| field | SFVec3f | center | 0 0 0 |
| field | SFVec3f | size | -1 -1 -1 |
| field | MFTime | reverbTime | 0 |
| field | MFFloat | reverbFreq | 1000 |
| exposedField | SFFloat | reverbLevel | 0.4 |
| exposedField | SFTime | reverbDelay | 0.5 |
| } | | | |

NOTE - For the binary encoding of this node see Annex H.3.2.

9.4.2.2.2. Functionality and semantics

AcousticScene is a node the parameters of which are used for rendering of the acoustic response of the environment, together with the acoustic reflectivity or transmission defined in the siblings or their sub-graphs of this **AcousticScene**. **AcousticScene** also defines three fields (**reverbTime**, **reverbFreq**, **reverbLevel**, and **reverbDelay**) which can be used to add reverberation to sounds that are affected by this node. Only audio that has been attached to the scene through a **DirectiveSound** node performing the *physical* rendering scheme is spatialized according to these definitions.

Only those **IndexedFaceSet** nodes that **AcousticMaterial** node is associated with, and that are defined in the siblings of **AcousticScene** (or in the sub-graph of the siblings) have effect on the room acoustic response that is applied to sound sources. Only **DirectiveSound** nodes that are currently positioned in a 3-D rectangular region defined by **center** and **size** fields, are affected by these acoustic surfaces. **size** field defines the size of a rectangular 3-D region where the parameters of **AcousticScene** and the acoustic surfaces in the siblings or sibling sub-graphs of the **AcousticScene** are taken into account in the auralization process (sound processing according to the acoustics of the environment). The default value of this field is -1, -1, -1.

center specifies the center of the above described region in the local coordinate system of the scene. Only when at the decoder a **DirectiveSound** and the **Viewpoint** (or **ListeningPoint**) are located within the same **AcousticScene** region defined by its **center** and **size** the sound attached to the **DirectiveSound** is heard. The default value (-1, -1, -1) of size equals to an infinite rectangular region (i.e., the sound is heard everywhere in the scene). **DirectiveSound** is rendered at one time only according to one **AcousticScene**, i.e., if the source and the viewpoint are in an overlapping area of several **AcousticScenes**, the one which is the first in the rendering order has effect on the **DirectiveSound**.

The **reverbTime** field specifies the reverberation time (time of 60 dB attenuation in the late reverberation response) at frequencies given in **reverbFreq** field to be applied to each **DirectiveSound** node that is within the 3-D region specified by the **AcousticScene**. This information is used for producing late reverberation at the maximum quality possible. With the default value 0, late reverberation is not added to the room response. It should be noted, however, that this field is useful for enabling simple room response modeling whenever there is not enough computational power to render several room reflections, or when the reflective properties of the surfaces are not specified. I.e., it is possible to specify a reverberant room with the boundaries defined by the **size** and **center** fields, even without specifying the reflectivity of individual surfaces. If only one value of **reverbTime** is given, it is taken as the reverberation time at the 1kHz frequency, and the decision about the frequency dependence of the reverberation time would be decided at the terminal (in natural environments the reverberation time decreases as a function of frequency). An example of **reverbTime** field is:

[2.0 0.5],

and example of **reverbFreq** is:

[0 16000],

yielding a late reverberation with a reverberation time of 2.0 s at 0 Hz frequency, and 0.5 s at 16000 Hz frequency.

reverbDelay specifies the time delay between the direct sound and the start of the reverberation in seconds. **reverbLevel** defines the level of the first output from the reverberator with respect to the direct sound.

In order to define which **AcousticScene** is applied to **DirectiveSound** in the case that it is positioned in an overlapping area of more than one **AcousticScene**, an **OrderedGroup** can be used above the various **AcousticScenes**.

9.4.2.3 Anchor

9.4.2.3.1 Node interface

| | | | |
|-----------------|----------|-----------------------|----|
| Anchor { | | | |
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFString | description | "" |
| exposedField | MFString | parameter | [] |
| exposedField | MFString | url | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex H.1.1.

9.4.2.3.2 Functionality and semantics

The semantics of the **Anchor** node are specified in ISO/IEC 14772-1:1998, subclause 6.2. ISO/IEC 14496-1 does not support the bounding box parameters (**bboxCenter** and **bboxSize**). Constraints on URLs are defined by profiles and levels.

9.4.2.4 AnimationStream

9.4.2.4.1 Node interface

| | | | |
|--------------------------|----------|------------------|-------|
| AnimationStream { | | | |
| exposedField | SFBool | loop | FALSE |
| exposedField | SFFloat | speed | 1.0 |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| exposedField | MFString | url | [""] |
| eventOut | SFBool | isActive | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.2](#).

9.4.2.4.2 Functionality and semantics

The **AnimationStream** node is designed to implement control parameters for a scene description stream.

The **loop**, **startTime**, and **stopTime** exposedFields and the **isActive** eventOut, and their effects on the **AnimationStream** node are described in 9.2.1.6.1.

The semantics of the **speed** exposedField are identical to those for the **MovieTexture** node (see 9.4.2.72).

The **url** field specifies the data source to be used. The data source referred to shall be a BIFS-Anim stream (see also 9.2.3.3) or a BIFS-Command stream. In both cases, the stream shall operate within the same name scope as the scene containing the **AnimationStream** node.

9.4.2.5 Appearance

9.4.2.5.1 Node interface

| | |
|---------------------|--|
| Appearance { | |
|---------------------|--|

| | | | |
|--------------|--------|-------------------------|------|
| exposedField | SFNode | material | NULL |
| exposedField | SFNode | texture | NULL |
| exposedField | SFNode | textureTransform | NULL |

{}

NOTE — For the binary encoding of this node see Annex [H.1.3](#).

9.4.2.5.2 Functionality and semantics

The semantics of the **Appearance** node are specified in ISO/IEC 14772-1:1998, subclause 6.3.

The **material** field, if non-NULL, shall contain either a **Material** node or a **Material2D** node depending on the type of geometry node used in the geometry field of the **Shape** node that contains the **Appearance** node. The list below shows the geometry nodes that require a **Material** node, those that require a **Material2D** node and those where either may apply:

- **Material2D** only: **Circle**, **Curve2D**, **IndexedFaceSet2D**, **IndexedLineSet2D**, **PointSet2D**, **Rectangle**;
- **Material** only: **Box**, **Cone**, **Cylinder**, **ElevationGrid**, **Extrusion**, **IndexedFaceSet**, **IndexedLineSet**, **PointSet**, **Sphere**;
- **Material2D** or **Material**: **Bitmap**, **Text**.

Inside a **Layer2D** node, if no **Appearance** and therefore no **Material2D** are defined, the default values and behavior of the **Material2D** node shall be used.

9.4.2.6 ApplicationWindow

9.4.2.6.1 Node interface

ApplicationWindow {

| | | | |
|--------------|----------|--------------------|-------|
| exposedField | SFBool | isActive | FALSE |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| exposedField | SFString | description | “” |
| exposedField | MFString | parameter | [] |
| exposedField | MFString | url | [] |
| exposedField | SFVec2f | size | 0, 0 |

}

NOTE - For the binary encoding of this node see Annex H.3.3.

9.4.2.6.2 Functionality and semantics

ApplicationWindow is an SF2DNode that allows an external application such as a web browser to exist within the MPEG-4 scene graph. Unlike a texture node, the windowed region is controlled and rendered by the external application, allowing natural user interaction with the application. The particular application to be opened is signaled in the **url** field, and any required parameters for starting the application may be placed in the **parameter** field.

The position of the application, its dimension and whether the application is active or not, is specified through BIFS scene authoring.

The **startTime** exposed field indicates when the application is to be started. The application is given control of the rendering window defined by the **size** field.

The **stopTime** exposedField indicates that the application is finished and should be shut down. The rendering window defined by the **size** field is returned to the MPEG-4 player.

The **isActive** exposedField signals the application to relinquish its rendering window to the MPEG-4 player, but to continue to run.

The **description** exposedField allows a prompt to be displayed as an alternative to the **url** in the **url** field. This choice should be user selectable.

The **parameter** exposedField carries parameters to be interpreted by the application decoder when the application window is instantiated.

The **url** exposedField carries the location of the windowed application.

The **size** exposedField provides the dimension (width and height) of the application window.

9.4.2.7 AudioBuffer

9.4.2.7.1 Node interface

| | | | |
|----------------------|---------|-------------------------|-------|
| AudioBuffer { | | | |
| exposedField | SFBool | loop | FALSE |
| exposedField | SFFloat | length | 0.0 |
| exposedField | SFFloat | pitch | 1.0 |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| exposedField | MFNode | children | [] |
| exposedField | SFIInt | numChan | 1 |
| exposedField | MFIInt | phaseGroup | [1] |
| eventOut | SFTime | duration_changed | |
| eventOut | SFBool | isActive | |

}

NOTE — For the binary encoding of this node see Annex H.1.4.

9.4.2.7.2 Functionality and semantics

The **AudioBuffer** node provides an interface to short snippets of sound to be used in an interactive scene.

EXAMPLE — Sounds triggered as “auditory icons” upon mouse clicks.

It buffers the audio generated by its children to support random restart capability upon interaction events. It differs from the **AudioClip** node in the following ways:

- **AudioBuffer** can be used in broadcast and other one-way applications in which URLs from remote locations cannot be retrieved interactively
- **AudioBuffer** can be used to trigger sounds made from processed sound (ie, with the other sound nodes) rather than only raw sound data as transmitted in the elementary stream

The **loop**, **startTime**, and **stopTime** exposedFields and the **isActive** eventOut, and their effects on the **AnimationStream** node are described in 9.2.1.6.1.

The semantics of the **speed** exposedField are identical to those for the **MovieTexture** node (see 9.4.2.72).

The **length** field specifies the length in seconds of the audio buffer. Audio shall be buffered at the instantiation of the node, and whenever the **length** field changes.

The **pitch** field specifies a pitch-shift to apply to the output sound. The pitch-shift is calculated by simple resampling; that is, a pitch-shift of 2 corresponds to playing the sound twice as fast and an octave higher. If **pitch** is negative, the buffer is played backwards at the indicated speed, beginning at the last sample in the buffer and proceeding to the first, then returning to the last sample if **loop** is TRUE.

The **children** field specifies the child nodes that provide the sound for this node. Each child shall be an AudioBIFS node; that is, one of the following: **AudioSource**, **AudioDelay**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip** or **AudioBuffer**.

An event shall be generated via the **duration_changed** field whenever a change is made to the **startTime** or **stopTime** fields. An event shall also be triggered if these fields are changed simultaneously, even if the duration does not actually change.

The **numChan** field specifies the number of output channels of this node. If there are more output channels than input channels, the “extra” channels shall contain all 0s; if there are more input channels than output channels, the “extra” channels shall be ignored.

The **phaseGroup** field specifies phase relationships in the output of the node, see 9.2.2.13 and 9.4.2.12.

The output of this node is not calculated based on the current input values, but according to the **startTime** event, the **pitch** field and the contents of the clip buffer. When the **startTime** is reached (that is, the current scene time is greater than or equal to **startTime**), the sound output shall begin at the beginning of the clip buffer and **isActive** shall be set to TRUE. At each time step thereafter, the value of the output buffer shall be the value of the next portion of the clip buffer, upsampled or downsampled as necessary according to **pitch**. When the end of the clip buffer according to the value of **length** is reached, if **loop** is TRUE, the audio shall begin again from the beginning of the clip buffer; if **loop** is FALSE, the playback shall cease. This playback shall be continued until **stopTime** is reached. When the current scene time is greater than or equal to **stopTime**, the node shall cease to produce sound.

The clip buffer shall be calculated as follows. When the node is instantiated, or whenever the **length** field is changed, the first **length** seconds of the audio input to the **AudioBuffer** node shall be copied to the clip buffer. That is, after $t < \text{length}$, audio sample number $t * S$ of channel i (where $0 \leq i < \text{numChan}$) in the buffer is set to contain the audio sample corresponding to time t of channel i of the input, where S is the sampling rate of this node. After the first **length** seconds, the input to this node has no effect. Changes to the **length** field that are received when **isActive** is TRUE shall be ignored.

When the playback is not active, the audio output of the node is all 0s.

9.4.2.8 AudioClip

9.4.2.8.1 Node interface

AudioClip {

| | | | |
|--------------|----------|-------------------------|-------|
| exposedField | SFString | description | "" |
| exposedField | SFBool | loop | FALSE |
| exposedField | SFFloat | pitch | 1.0 |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| exposedField | MFString | url | [] |
| eventOut | SFTime | duration_changed | |
| eventOut | SFBool | isActive | |

}

NOTE — For the binary encoding of this node see Annex [H.1.5](#).

9.4.2.8.2 Functionality and semantics

The semantics of the **Audioclip** node are specified in ISO/IEC 14772-1:1998, subclause 6.4.

The **loop**, **startTime**, and **stopTime** exposedFields and the **isActive** eventOut, and their effects on the **AudioClip** node are described in 9.2.1.6.1.

The **url** field specifies the data source to be used (see 9.2.2.7.1).

9.4.2.9 AudioDelay

9.4.2.9.1 Node interface

AudioDelay {

| | | | |
|--------------|---------|-----------------------|----|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFTime | delay | 0 |
| field | SFInt32 | numChan | 1 |
| field | MFInt32 | phaseGroup | [] |

{}

NOTE — For the binary encoding of this node see Annex [H.1.6](#).

9.4.2.9.2 Functionality and semantics

The **AudioDelay** node allows sounds to be started and stopped under temporal control. The start time and stop time of the child sounds are delayed or advanced accordingly.

The **addChildren** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** array specifies the nodes affected by the delay. Each child shall be an AudioBIFS node; that is, one of the following: **AudioSource**, **AudioDelay**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip** or **AudioBuffer**.

The **delay** field specifies the delay to apply to each child node.

The **numChan** field specifies the number of channels of audio output by this node.

The **phaseGroup** field specifies the phase relationships among the various output channels; see 9.2.1.6.1.

Implementation of the **AudioDelay** node requires the use of a buffer of size $d * S * n$, where d is the length of the delay in seconds, S is the sampling rate of the node, and n is the number of output channels from this node. At scene startup, a multichannel delay line of length d and width n is initialized to reside in this buffer.

At each time step, the $k * S$ audio samples in each channel of the input buffer, where k is the length of the system time step in seconds, are inserted into this delay line. If the number of input channels is strictly greater than the number of output channels, the extra input channels are ignored; if the number of input channels is strictly less than the number of output channels, the extra channels of the delay line shall be taken as all 0's.

The output buffer of the node is the $k * S$ audio samples which fall off the end of the delay line in this process. Note that this definition holds regardless of the relationship between k and d .

If the **delay** field is updated during playback, discontinuities (audible artefacts or “clicks”) in the output sound may result. If the **delay** field is updated to a greater value than the current value, the delay line is immediately extended to the new length, and zero values inserted at the beginning, so that $d * S$ seconds later there will be a short gap in the output of the node. If the **delay** field is updated to a lesser value than the current value, the delay line is immediately shortened to the new length, truncating the values at the end of the line, so that there is an immediate discontinuity in sound output. Manipulation of the **delay** field in this manner is not recommended unless the audio is muted within the terminal or by appropriate use of an **AudioMix** node at the same time, since it gives rise to impaired sound quality.

9.4.2.10 AudioFX

9.4.2.10.1 Node interface

AudioFX {

| | | | |
|--------------|----------|-----------------------|----|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFString | orch | "" |
| exposedField | SFString | score | "" |
| exposedField | MFFloat | params | [] |
| field | SFI32 | numChan | 1 |
| field | MFI32 | phaseGroup | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.7](#).

9.4.2.10.2 Functionality and semantics

The **AudioFX** node is used to allow arbitrary signal-processing functions defined using structured audio tools to be included and applied to its **children** (see ISO/IEC 14496-3, subpart 5, clause 5.15).

The **addChildren** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** array contains the nodes operated upon by this effect. Each child shall be an AudioBIFS node; that is, one of the following: **AudioSource**, **AudioDelay**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip** or **AudioBuffer**. If this array is empty, the node has no function (the node may not be used to create new synthetic audio in the middle of a scene graph).

The **orch** string contains a tokenised block of signal-processing code written in SAOL (Structured Audio Orchestra Language). This code block shall contain an orchestra header and some instrument definitions, and conform to the bitstream syntax of the orchestra class as defined in ISO/IEC 14496-3, subpart 5, subclause 5.5.2.2 and clause 5.8.

The **score** string may contain a tokenized score for the given orchestra written in SASL (Structured Audio Score Language). This score may contain control operators to adjust the parameters of the orchestra, or even new instrument instantiations. A **score** is not required. If present it shall conform to the bitstream syntax of the **score_file** class as defined in ISO/IEC 14496-3, subpart 5, subclause 5.5.2 and clause 5.11.

The **params** field allows BIFS commands and events to affect the sound-generation process in the orchestra. The values of **params** are available to the FX orchestra as the global array `global ksig params[128]`; see ISO/IEC 14496-3, subpart 5, clause 5.15.

The **numchan** field specifies the number of channels of audio output by this node.

The **phaseGroup** field specifies the phase relationships among the various output channels; see 9.2.1.6.1.

The node is evaluated according to the semantics of the orchestra code contained in the **orch** field. See ISO/IEC 14496-3, subpart 5, for the normative description of this process. Within the orchestra code, the multiple channels of input sound are placed on the global bus, *input_bus*; first, all channels of the first child, then all the channels of the second child, and so on. The orchestra header shall ‘send’ this bus to an instrument for processing. The **phaseGroup** arrays of the children are made available as the *inGroup* variable within the instrument(s) to which the *input_bus* is sent.

The orchestra code block shall not contain the **spatialize** statement.

The output buffer of this node is the sound produced as the final output of the orchestra applied to the input sounds, as described in ISO/IEC 14496-3, subpart 5, subclauses 5.7.3.

9.4.2.11 AudioMix

9.4.2.11.1 Node interface

AudioMix {

| | | | |
|--------------|---------|-----------------------|----|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFInt32 | numInputs | 1 |
| exposedField | MFFloat | matrix | [] |
| field | SFInt32 | numChan | 1 |
| field | MFInt32 | phaseGroup | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.8](#).

9.4.2.11.2 Functionality and semantics

This node is used to mix together several audio signals in a simple, multiplicative way. Any relationship that may be specified in terms of a mixing matrix may be described using this node.

The **addChildren** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** field specifies which nodes' outputs to mix together. Each child shall be an AudioBIFS node; that is, one of the following: **AudioSource**, **AudioDelay**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip** or **AudioBuffer**.

The **numInputs** field specifies the number of input channels. It shall be the sum of the number of channels of the children.

The **matrix** array specifies the mixing matrix which relates the inputs to the outputs. **matrix** is an unrolled **numInputs** x **numChan** matrix which describes the relationship between **numInputs** input channels and **numChan** output channels. The **numInputs** * **numChan** values are in row-major order. That is, the first **numInputs** values are the scaling factors applied to each of the inputs to produce the first output channel; the next **numInputs** values produce the second output channel, and so forth.

That is, if the desired mixing matrix is $\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$, specifying a “2 into 3” mix, the value of the **matrix** field shall be $[a\ b\ c\ d\ e\ f]$.

The **numchan** field specifies the number of channels of audio output by this node.

The **phaseGroup** field specifies the phase relationships among the various output channels; see 9.2.1.6.1.

The value of the output buffer for an **AudioMix** node is calculated as follows. For each sample number *x* of output channel *i*, $1 \leq i \leq \text{numChan}$, the value of that sample is

```

matrix[ (0) * numChan + i ] * input[1][x] +
matrix[ (1) * numChan + i ] * input[2][x] + ...
matrix[ (numInputs - 1) * numChan + i ] * input[numInputs][x],

```

where **input[j][j]** represents the *j*th sample of the *i*th channel of the input buffer, and the **matrix** elements are indexed starting from 1.

9.4.2.12 AudioSource

9.4.2.12.1 Node interface

AudioSource {

| | | | |
|--------------|----------|-----------------------|-----|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | MFString | url | [] |
| exposedField | SFFloat | pitch | 1.0 |
| exposedField | SFFloat | speed | 1.0 |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| field | SFInt32 | numChan | 1 |
| field | MFIInt32 | phaseGroup | [] |

{}

NOTE — For the binary encoding of this node see Annex [H.1.9](#).

9.4.2.12.2 Functionality and semantics

This node is used to add sound to a BIFS scene. See ISO/IEC 14496-3 for information on the various audio tools available for coding sound.

The **addChildren** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** field allows buffered **AudioBuffer** data to be used as sound samples within a structured audio decoding process. Only **AudioBuffer** nodes shall be children to an **AudioSource** node, and only in the case where **url** indicates a structured audio bitstream.

The **pitch** field controls the playback pitch for the structured audio and the parametric speech (HVXC) decoder. It is specified as a ratio, where 1 indicates the original bitstream pitch, values other than 1 indicate pitch-shifting by the given ratio. This field is available through the `gettune()` core opcode in the structured audio decoder (see ISO/IEC 14496-3, subpart 5). The structured audio is the only decoder that may be controlled in this manner; to adjust the pitch of other decoder types, use the **AudioFX** node with an appropriate effects orchestra.

The **speed** field controls the playback speed for the structured audio decoder (see ISO/IEC 14496-3, subpart 5). It is specified as a ratio, where 1 indicates the original speed; values other than 1 indicate multiplicative time-scaling by the given ratio (i.e. 0.5 specifies twice as fast). The value of this field shall be made available to the structured audio decoder indicated by the **url** field. ISO/IEC 14496-3, subpart 5, subclause 5.7.3.3.6, list item 8, describe the use of this field to control the structured audio decoder. The structured audio decoder is the only decoder that may be controlled in this manner; to adjust the speed of other decoder types, use the **AudioFX** node with an appropriate orchestra.

The **startTime** and **stopTime** exposedFields and their effects on the **AudioSource** node are described in 9.2.1.6.1.

The **numChan** field describes how many channels of audio are in the decoded bitstream.

The **phaseGroup** array specifies whether or not there are important phase relationships between the multiple channels of audio. If there are such relationships – for example, if the sound is a multichannel spatialized set or a “stereo pair” – it is in general dangerous to do anything more complex than scaling to the sound. Further filtering or repeated “spatialization” will destroy these relationships. The values in the array divide the channels of audio into groups; if **phaseGroup[i] = phaseGroup[j]** then channel **i** and channel **j** are phase-related. Channels for which the **phaseGroup** value is 0 are not related to any other channel.

The **url** field specifies the data source to be used (see 9.2.2.7.1).

The audio output from the decoder according to the bitstream(s), referenced in the specified URL, at the current scene time is placed in the output buffer for this node, unless the current scene time is earlier than the current value of **startTime** or later than the current value of **stopTime**, in which case 0 values are placed in the output buffer for this node for the current scene time.

For audio sources decoded using the main object of the structured audio decoder (ISO/IEC 14496-3, subpart 5), several variables from the scene description must be mapped into standard names in the orchestra. See ISO/IEC 14496-3, subpart 5, clause 5.15 and subclause 5.8.6.8.

If **AudioBuffer** children are provided for a structured audio decoder, the audio data buffered in the **AudioBuffer**(s) must be made available to the decoding process. See Subclause ISO/IEC 14496-3, subpart 5, subclause 5.10.2.

9.4.2.13 AudioSwitch

9.4.2.13.1 Node interface

| | | | |
|----------------------|--------|-----------------------|----|
| AudioSwitch { | | | |
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | MFI32 | whichChoice | [] |
| field | SFI32 | numChan | 1 |
| field | MFI32 | phaseGroup | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.10](#).

9.4.2.13.2 Functionality and semantics

The **AudioSwitch** node is used to select a subset of audio channels from the child nodes specified.

The **addChildren** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** field specifies a list of child options. Each child shall be an AudioBIFS node; that is, one of the following: **AudioSource**, **AudioDelay**, **AudioMix**, **AudioSwitch**, **AudioFX**, **AudioClip** or **AudioBuffer**.

The **whichChoice** field specifies which channels shall be passed through. If **whichChoice[i]** is 1, then the i-th child channel shall be passed through.

The **numchan** field specifies the number of channels of audio output by this node; ie, the number of channels in the passed child.

The **phaseGroup** field specifies the phase relationships among the various output channels; see 9.2.1.6.1.

The values for the output buffer are calculated as follows:

For each sample number x of channel number i of the output buffer, $1 \leq i \leq \text{numChan}$, the value in the buffer is the same as the value of sample number x in the j th channel of the input, where j is the least value such that **whichChoice[0] + whichChoice[1] + ... + whichChoice[j] = i**.

9.4.2.14 Background

9.4.2.14.1 Node interface

| | | | |
|---------------------|----------|--------------------|----|
| Background { | | | |
| eventIn | SFBool | set_bind | |
| exposedField | MFFloat | groundAngle | [] |
| exposedField | MFCOLOR | groundColor | [] |
| exposedField | MFString | backURL | [] |
| exposedField | MFString | bottomURL | [] |
| exposedField | MFString | frontURL | [] |
| exposedField | MFString | leftURL | [] |
| exposedField | MFString | rightURL | [] |

| | | | |
|--------------|----------|-----------------|-----------|
| exposedField | MFString | topURL | [] |
| exposedField | MFFloat | skyAngle | [] |
| exposedField | MFColor | skyColor | [0, 0, 0] |
| eventOut | SFBool | isBound | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.11](#).

9.4.2.14.2 Functionality and semantics

The semantics of the **Background** node are specified in ISO/IEC 14772-1:1998, subclause 6.5.

The **backUrl**, **bottomURL**, **frontUrl**, **leftUrl**, **rightUrl**, **topUrl** fields specify the data sources to be used (see 9.2.2.7.1).

9.4.2.15 Background2D

9.4.2.15.1 Node interface

| | | | |
|-----------------------|----------|------------------|-------|
| Background2D { | | | |
| eventIn | SFBool | set_bind | |
| exposedField | SFColor | backColor | 0 0 0 |
| exposedField | MFString | url | [] |
| eventOut | SFBool | isBound | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.12](#).

9.4.2.15.2 Functionality and semantics

There exists a **Background2D** stack, in which the top-most background is the current active background one. The **Background2D** node allows a background to be displayed behind a 2D scene. The functionality of this node can also be accomplished using other nodes, but use of this node may be more efficient in some implementations.

If **set_bind** is set to TRUE the **Background2D** is moved to the top of the stack. If **set_bind** is set to FALSE, the **Background2D** is removed from the stack so the previous background which is contained in the stack is on top again.

The **isBound** event is sent as soon as the backdrop is put at the top of the stack, so becoming the current backdrop.

The **url** field specifies the data source to be used (see 9.2.2.7.1).

The **backColor** field specifies a colour to be used as the background.

This is not a geometry node. The top-left corner of the image is mapped to the top-left corner of the **Layer2D** and the right-bottom corner of the image is stretched to the right-bottom corner of the **Layer2D**, regardless of the current transformation. Scaling and/or rotation do not have any effect on this node. The background image will always exactly fill the entire **Layer2D**, regardless of **Layer2D** size, without tiling or cropping.

EXAMPLE — Changing the background for 5 seconds.

```
Group {
  children [
    ...
    DEF TIS TimeSensor {
      startTime 5.0
      stopTime 10.0
    }
    DEF BG1 Background2D {
      ...
    }
  ]
}
```

```
]
}

ROUTE TIS.isActive TO BG1.set_bind
```

9.4.2.16 BAP

9.4.2.16.1 Node interface

| BAP { | | | |
|--------------|---------|-----------------------------------|----|
| exposedField | SFInt32 | sacroiliac_tilt | +I |
| exposedField | SFInt32 | sacroiliac_torsion | +I |
| exposedField | SFInt32 | sacroiliac_roll | +I |
| exposedField | SFInt32 | l_hip_flexion | +I |
| exposedField | SFInt32 | r_hip_flexion | +I |
| exposedField | SFInt32 | l_hip_abduct | +I |
| exposedField | SFInt32 | r_hip_abduct | +I |
| exposedField | SFInt32 | l_hip_twisting | +I |
| exposedField | SFInt32 | r_hip_twisting | +I |
| exposedField | SFInt32 | l_knee_flexion | +I |
| exposedField | SFInt32 | r_knee_flexion | +I |
| exposedField | SFInt32 | l_knee_twisting | +I |
| exposedField | SFInt32 | r_knee_twisting | +I |
| exposedField | SFInt32 | l_ankle_flexion | +I |
| exposedField | SFInt32 | r_ankle_flexion | +I |
| exposedField | SFInt32 | l_ankle_twisting | +I |
| exposedField | SFInt32 | r_ankle_twisting | +I |
| exposedField | SFInt32 | l_subtalar_flexion | +I |
| exposedField | SFInt32 | r_subtalar_flexion | +I |
| exposedField | SFInt32 | l_middatarsal_flexion | +I |
| exposedField | SFInt32 | r_middatarsal_flexion | +I |
| exposedField | SFInt32 | l_metatarsal_flexion | +I |
| exposedField | SFInt32 | r_metatarsal_flexion | +I |
| exposedField | SFInt32 | l_sternoclavicular_abduct | +I |
| exposedField | SFInt32 | r_sternoclavicular_abduct | +I |
| exposedField | SFInt32 | l_sternoclavicular_rotate | +I |
| exposedField | SFInt32 | r_sternoclavicular_rotate | +I |
| exposedField | SFInt32 | l_acromioclavicular_abduct | +I |
| exposedField | SFInt32 | r_acromioclavicular_abduct | +I |
| exposedField | SFInt32 | l_acromioclavicular_rotate | +I |
| exposedField | SFInt32 | r_acromioclavicular_rotate | +I |
| exposedField | SFInt32 | l_shoulder_flexion | +I |
| exposedField | SFInt32 | r_shoulder_flexion | +I |
| exposedField | SFInt32 | l_shoulder_abduct | +I |
| exposedField | SFInt32 | r_shoulder_abduct | +I |
| exposedField | SFInt32 | l_shoulder_twisting | +I |
| exposedField | SFInt32 | r_shoulder_twisting | +I |
| exposedField | SFInt32 | l_elbow_flexion | +I |
| exposedField | SFInt32 | r_elbow_flexion | +I |
| exposedField | SFInt32 | l_elbow_twisting | +I |
| exposedField | SFInt32 | r_elbow_twisting | +I |
| exposedField | SFInt32 | l_wrist_flexion | +I |
| exposedField | SFInt32 | r_wrist_flexion | +I |
| exposedField | SFInt32 | l_wrist_pivot | +I |
| exposedField | SFInt32 | r_wrist_pivot | +I |
| exposedField | SFInt32 | l_wrist_twisting | +I |
| exposedField | SFInt32 | r_wrist_twisting | +I |
| exposedField | SFInt32 | skullbase_roll | +I |
| exposedField | SFInt32 | skullbase_torsion | +I |
| exposedField | SFInt32 | skullbase_tilt | +I |
| exposedField | SFInt32 | vc1roll | +I |
| exposedField | SFInt32 | vc1torsion | +I |
| exposedField | SFInt32 | vc1tilt | +I |
| exposedField | SFInt32 | vc2roll | +I |

| | | | |
|--------------|---------|--------------------|----|
| exposedField | SFInt32 | vc2torsion | +I |
| exposedField | SFInt32 | vc2tilt | +I |
| exposedField | SFInt32 | vc3roll | +I |
| exposedField | SFInt32 | vc3torsion | +I |
| exposedField | SFInt32 | vc3tilt | +I |
| exposedField | SFInt32 | vc4roll | +I |
| exposedField | SFInt32 | vc4torsion | +I |
| exposedField | SFInt32 | vc4tilt | +I |
| exposedField | SFInt32 | vc5roll | +I |
| exposedField | SFInt32 | vc5torsion | +I |
| exposedField | SFInt32 | vc5tilt | +I |
| exposedField | SFInt32 | vc6roll | +I |
| exposedField | SFInt32 | vc6torsion | +I |
| exposedField | SFInt32 | vc6tilt | +I |
| exposedField | SFInt32 | vc7roll | +I |
| exposedField | SFInt32 | vc7torsion | +I |
| exposedField | SFInt32 | vc7tilt | +I |
| exposedField | SFInt32 | vt1roll | +I |
| exposedField | SFInt32 | vt1torsion | +I |
| exposedField | SFInt32 | vt1tilt | +I |
| exposedField | SFInt32 | vt2roll | +I |
| exposedField | SFInt32 | vt2torsion | +I |
| exposedField | SFInt32 | vt2tilt | +I |
| exposedField | SFInt32 | vt3roll | +I |
| exposedField | SFInt32 | vt3torsion | +I |
| exposedField | SFInt32 | vt3tilt | +I |
| exposedField | SFInt32 | vt4roll | +I |
| exposedField | SFInt32 | vt4torsion | +I |
| exposedField | SFInt32 | vt4tilt | +I |
| exposedField | SFInt32 | vt5roll | +I |
| exposedField | SFInt32 | vt5torsion | +I |
| exposedField | SFInt32 | vt5tilt | +I |
| exposedField | SFInt32 | vt6roll | +I |
| exposedField | SFInt32 | vt6torsion | +I |
| exposedField | SFInt32 | vt6tilt | +I |
| exposedField | SFInt32 | vt7roll | +I |
| exposedField | SFInt32 | vt7torsion | +I |
| exposedField | SFInt32 | vt7tilt | +I |
| exposedField | SFInt32 | vt8roll | +I |
| exposedField | SFInt32 | vt8torsion | +I |
| exposedField | SFInt32 | vt8tilt | +I |
| exposedField | SFInt32 | vt9roll | +I |
| exposedField | SFInt32 | vt9torsion | +I |
| exposedField | SFInt32 | vt9tilt | +I |
| exposedField | SFInt32 | vt10roll | +I |
| exposedField | SFInt32 | vt10torsion | +I |
| exposedField | SFInt32 | vt10tilt | +I |
| exposedField | SFInt32 | vt11roll | +I |
| exposedField | SFInt32 | vt11torsion | +I |
| exposedField | SFInt32 | vt11tilt | +I |
| exposedField | SFInt32 | vt12roll | +I |
| exposedField | SFInt32 | vt12torsion | +I |
| exposedField | SFInt32 | vt12tilt | +I |
| exposedField | SFInt32 | vl1roll | +I |
| exposedField | SFInt32 | vl1torsion | +I |
| exposedField | SFInt32 | vl1tilt | +I |
| exposedField | SFInt32 | vl2roll | +I |
| exposedField | SFInt32 | vl2torsion | +I |
| exposedField | SFInt32 | vl2tilt | +I |
| exposedField | SFInt32 | vl3roll | +I |
| exposedField | SFInt32 | vl3torsion | +I |
| exposedField | SFInt32 | vl3tilt | +I |

| | | | |
|--------------|---------|---------------------------|----|
| exposedField | SFInt32 | vl4roll | +l |
| exposedField | SFInt32 | vl4torsion | +l |
| exposedField | SFInt32 | vl4tilt | +l |
| exposedField | SFInt32 | vl5roll | +l |
| exposedField | SFInt32 | vl5torsion | +l |
| exposedField | SFInt32 | vl5tilt | +l |
| exposedField | SFInt32 | l_pinky0_flexion | +l |
| exposedField | SFInt32 | r_pinky0_flexion | +l |
| exposedField | SFInt32 | l_pinky1_flexion | +l |
| exposedField | SFInt32 | r_pinky1_flexion | +l |
| exposedField | SFInt32 | l_pinky1_pivot | +l |
| exposedField | SFInt32 | r_pinky1_pivot | +l |
| exposedField | SFInt32 | l_pinky1_twisting | +l |
| exposedField | SFInt32 | r_pinky1_twisting | +l |
| exposedField | SFInt32 | l_pinky2_flexion | +l |
| exposedField | SFInt32 | r_pinky2_flexion | +l |
| exposedField | SFInt32 | l_pinky3_flexion | +l |
| exposedField | SFInt32 | r_pinky3_flexion | +l |
| exposedField | SFInt32 | l_ring0_flexion | +l |
| exposedField | SFInt32 | r_ring0_flexion | +l |
| exposedField | SFInt32 | l_ring1_flexion | +l |
| exposedField | SFInt32 | r_ring1_flexion | +l |
| exposedField | SFInt32 | l_ring1_pivot | +l |
| exposedField | SFInt32 | r_ring1_pivot | +l |
| exposedField | SFInt32 | l_ring1_twisting | +l |
| exposedField | SFInt32 | r_ring1_twisting | +l |
| exposedField | SFInt32 | l_ring2_flexion | +l |
| exposedField | SFInt32 | r_ring2_flexion | +l |
| exposedField | SFInt32 | l_ring3_flexion | +l |
| exposedField | SFInt32 | r_ring3_flexion | +l |
| exposedField | SFInt32 | l_middle0_flexion | +l |
| exposedField | SFInt32 | r_middle0_flexion | +l |
| exposedField | SFInt32 | l_middle1_flexion | +l |
| exposedField | SFInt32 | r_middle1_flexion | +l |
| exposedField | SFInt32 | l_middle1_pivot | +l |
| exposedField | SFInt32 | r_middle1_pivot | +l |
| exposedField | SFInt32 | l_middle1_twisting | +l |
| exposedField | SFInt32 | r_middle1_twisting | +l |
| exposedField | SFInt32 | l_middle2_flexion | +l |
| exposedField | SFInt32 | r_middle2_flexion | +l |
| exposedField | SFInt32 | l_middle3_flexion | +l |
| exposedField | SFInt32 | r_middle3_flexion | +l |
| exposedField | SFInt32 | l_index0_flexion | +l |
| exposedField | SFInt32 | r_index0_flexion | +l |
| exposedField | SFInt32 | l_index1_flexion | +l |
| exposedField | SFInt32 | r_index1_flexion | +l |
| exposedField | SFInt32 | l_index1_pivot | +l |
| exposedField | SFInt32 | r_index1_pivot | +l |
| exposedField | SFInt32 | l_index1_twisting | +l |
| exposedField | SFInt32 | r_index1_twisting | +l |
| exposedField | SFInt32 | l_index2_flexion | +l |
| exposedField | SFInt32 | r_index2_flexion | +l |
| exposedField | SFInt32 | l_index3_flexion | +l |
| exposedField | SFInt32 | r_index3_flexion | +l |
| exposedField | SFInt32 | l_thumb1_flexion | +l |
| exposedField | SFInt32 | r_thumb1_flexion | +l |
| exposedField | SFInt32 | l_thumb1_pivot | +l |
| exposedField | SFInt32 | r_thumb1_pivot | +l |
| exposedField | SFInt32 | l_thumb1_twisting | +l |
| exposedField | SFInt32 | r_thumb1_twisting | +l |
| exposedField | SFInt32 | l_thumb2_flexion | +l |
| exposedField | SFInt32 | r_thumb2_flexion | +l |

| | | | |
|--------------|---------|----------------------------------|----|
| exposedField | SFInt32 | l_thumb3_flexion | +I |
| exposedField | SFInt32 | r_thumb3_flexion | +I |
| exposedField | SFInt32 | humanoidRoot_tr_vertical | +I |
| exposedField | SFInt32 | humanoidRoot_tr_lateral | +I |
| exposedField | SFInt32 | humanoidRoot_tr_frontal | +I |
| exposedField | SFInt32 | humanoidRoot_rt_body_turn | +I |
| exposedField | SFInt32 | humanoidRoot_rt_body_roll | +I |
| exposedField | SFInt32 | humanoidRoot_rt_body_tilt | +I |
| exposedField | SFInt32 | extensionBap187 | +I |
| exposedField | SFInt32 | extensionBap188 | +I |
| exposedField | SFInt32 | extensionBap189 | +I |
| exposedField | SFInt32 | extensionBap190 | +I |
| exposedField | SFInt32 | extensionBap191 | +I |
| exposedField | SFInt32 | extensionBap192 | +I |
| exposedField | SFInt32 | extensionBap193 | +I |
| exposedField | SFInt32 | extensionBap194 | +I |
| exposedField | SFInt32 | extensionBap195 | +I |
| exposedField | SFInt32 | extensionBap196 | +I |
| exposedField | SFInt32 | extensionBap197 | +I |
| exposedField | SFInt32 | extensionBap198 | +I |
| exposedField | SFInt32 | extensionBap199 | +I |
| exposedField | SFInt32 | extensionBap200 | +I |
| exposedField | SFInt32 | extensionBap201 | +I |
| exposedField | SFInt32 | extensionBap202 | +I |
| exposedField | SFInt32 | extensionBap203 | +I |
| exposedField | SFInt32 | extensionBap204 | +I |
| exposedField | SFInt32 | extensionBap205 | +I |
| exposedField | SFInt32 | extensionBap206 | +I |
| exposedField | SFInt32 | extensionBap207 | +I |
| exposedField | SFInt32 | extensionBap208 | +I |
| exposedField | SFInt32 | extensionBap209 | +I |
| exposedField | SFInt32 | extensionBap210 | +I |
| exposedField | SFInt32 | extensionBap211 | +I |
| exposedField | SFInt32 | extensionBap212 | +I |
| exposedField | SFInt32 | extensionBap213 | +I |
| exposedField | SFInt32 | extensionBap214 | +I |
| exposedField | SFInt32 | extensionBap215 | +I |
| exposedField | SFInt32 | extensionBap216 | +I |
| exposedField | SFInt32 | extensionBap217 | +I |
| exposedField | SFInt32 | extensionBap218 | +I |
| exposedField | SFInt32 | extensionBap219 | +I |
| exposedField | SFInt32 | extensionBap220 | +I |
| exposedField | SFInt32 | extensionBap221 | +I |
| exposedField | SFInt32 | extensionBap222 | +I |
| exposedField | SFInt32 | extensionBap223 | +I |
| exposedField | SFInt32 | extensionBap224 | +I |
| exposedField | SFInt32 | extensionBap225 | +I |
| exposedField | SFInt32 | extensionBap226 | +I |
| exposedField | SFInt32 | extensionBap227 | +I |
| exposedField | SFInt32 | extensionBap228 | +I |
| exposedField | SFInt32 | extensionBap229 | +I |
| exposedField | SFInt32 | extensionBap230 | +I |
| exposedField | SFInt32 | extensionBap231 | +I |
| exposedField | SFInt32 | extensionBap232 | +I |
| exposedField | SFInt32 | extensionBap233 | +I |
| exposedField | SFInt32 | extensionBap234 | +I |
| exposedField | SFInt32 | extensionBap235 | +I |
| exposedField | SFInt32 | extensionBap236 | +I |
| exposedField | SFInt32 | extensionBap237 | +I |
| exposedField | SFInt32 | extensionBap238 | +I |
| exposedField | SFInt32 | extensionBap239 | +I |
| exposedField | SFInt32 | extensionBap240 | +I |

| | | | |
|--------------|---------|------------------------|----|
| exposedField | SFInt32 | extensionBap241 | +l |
| exposedField | SFInt32 | extensionBap242 | +l |
| exposedField | SFInt32 | extensionBap243 | +l |
| exposedField | SFInt32 | extensionBap244 | +l |
| exposedField | SFInt32 | extensionBap245 | +l |
| exposedField | SFInt32 | extensionBap246 | +l |
| exposedField | SFInt32 | extensionBap247 | +l |
| exposedField | SFInt32 | extensionBap248 | +l |
| exposedField | SFInt32 | extensionBap249 | +l |
| exposedField | SFInt32 | extensionBap250 | +l |
| exposedField | SFInt32 | extensionBap251 | +l |
| exposedField | SFInt32 | extensionBap252 | +l |
| exposedField | SFInt32 | extensionBap253 | +l |
| exposedField | SFInt32 | extensionBap254 | +l |
| exposedField | SFInt32 | extensionBap255 | +l |
| exposedField | SFInt32 | extensionBap256 | +l |
| exposedField | SFInt32 | extensionBap257 | +l |
| exposedField | SFInt32 | extensionBap258 | +l |
| exposedField | SFInt32 | extensionBap259 | +l |
| exposedField | SFInt32 | extensionBap260 | +l |
| exposedField | SFInt32 | extensionBap261 | +l |
| exposedField | SFInt32 | extensionBap262 | +l |
| exposedField | SFInt32 | extensionBap263 | +l |
| exposedField | SFInt32 | extensionBap264 | +l |
| exposedField | SFInt32 | extensionBap265 | +l |
| exposedField | SFInt32 | extensionBap266 | +l |
| exposedField | SFInt32 | extensionBap267 | +l |
| exposedField | SFInt32 | extensionBap268 | +l |
| exposedField | SFInt32 | extensionBap269 | +l |
| exposedField | SFInt32 | extensionBap270 | +l |
| exposedField | SFInt32 | extensionBap271 | +l |
| exposedField | SFInt32 | extensionBap272 | +l |
| exposedField | SFInt32 | extensionBap273 | +l |
| exposedField | SFInt32 | extensionBap274 | +l |
| exposedField | SFInt32 | extensionBap275 | +l |
| exposedField | SFInt32 | extensionBap276 | +l |
| exposedField | SFInt32 | extensionBap277 | +l |
| exposedField | SFInt32 | extensionBap278 | +l |
| exposedField | SFInt32 | extensionBap279 | +l |
| exposedField | SFInt32 | extensionBap280 | +l |
| exposedField | SFInt32 | extensionBap281 | +l |
| exposedField | SFInt32 | extensionBap282 | +l |
| exposedField | SFInt32 | extensionBap283 | +l |
| exposedField | SFInt32 | extensionBap284 | +l |
| exposedField | SFInt32 | extensionBap285 | +l |
| exposedField | SFInt32 | extensionBap286 | +l |
| exposedField | SFInt32 | extensionBap287 | +l |
| exposedField | SFInt32 | extensionBap288 | +l |
| exposedField | SFInt32 | extensionBap289 | +l |
| exposedField | SFInt32 | extensionBap290 | +l |
| exposedField | SFInt32 | extensionBap291 | +l |
| exposedField | SFInt32 | extensionBap292 | +l |
| exposedField | SFInt32 | extensionBap293 | +l |
| exposedField | SFInt32 | extensionBap294 | +l |
| exposedField | SFInt32 | extensionBap295 | +l |
| exposedField | SFInt32 | extensionBap296 | +l |

{}

NOTE - For the binary encoding of this node see Annex [H.3.4](#).

9.4.2.16.2 Functionality and semantics

BAP defines the current look of the body by means of body animation parameters. The semantics of the fields of **BAP** is described in Annex C of ISO/IEC 14496-2: 1999.

9.4.2.17 BDP

9.4.2.17.1 Semantic Table

| | | | |
|---------------------|----------------------------------|----|--|
| BDP { | | | |
| exposedField MFNode | bodySceneGraph | [] | |
| exposedField MFNode | bodyDefTables | [] | |
| exposedField MFNode | bodySegmentConnectionHint | [] | |
| } | | | |

NOTE - For the binary encoding of this node see Annex [H.3.5](#)

9.4.2.17.2 Funcionality and semantics

The **BDP** node is used to customize the proprietary body model of the decoder to a particular body, or to download a body model along with the information of how to animate it. The Body Definition Parameters (BDPs) are normally transmitted once per session, followed by a stream of coded Body Animation Parameters (BAPs). It is also possible to transmit BDPs more than once per session. If the decoder does not receive the BDPs, the use of a default model ensures that it can still interpret the FBA stream containing BAPs. This insures minimal operation in broadcast or teleconferencing applications.

BDPs specify the following properties:

1. Body surface geometry (with texture coordinates if texture is used)
- The body surface geometry is downloaded using the BIFS stream. The body geometry surfaces are specified using the BIFS **Segment** PROTO definitions as defined In Annex [M.2](#).
2. Joint center locations.
 - The positions of the joints are specified using the BIFS **Joint** PROTO definitions.
 - Texture images as part of the BIFS **Segment** definitions.
3. Deformation tables, that describe how to deform the body surfaces using the received BAPs.

The scene graph or a body definition is strongly based on ISO/IEC 14772-1 Amendment 1. The texture images can be defined for each surface. Note that the texture images are part of the PROTO SEGMENT geometry, defined in Annex M.

The following are the basic assumptions about BDP:

1. Default posture to initialize a human body model.
- Standing posture: This posture is defined as follows: the feet should point to the front direction, the two arms should be placed on the side of the body with the palm of the hands facing inward. This posture also implies that all BAPs have value zero (see ISO/IEC 14496-2:1999).
2. Establishing the coordinate system.

The origin of the body coordinate system is located at ground (y=0) level, between the humanoid's feet, with the lateral and frontal position the same as spine origin (l5tilt). The orientation of the coordinate is x points to the left, y points up, and z points to the front of the humanoid. The BDP node defines the body model to be used at the receiver. Two options are supported:

- The **bodyDefTables** is [], the body scene graph is downloaded, in which case the proprietary body of the decoder has to be replaced by the downloaded graph. The **bodySceneGraph** field has to be in the syntax described in Annex M.

- The **bodyDefTables** is different from [], in which case the decoder has to replace its local model by the downloaded graph. The **bodySceneGraph** field has to be in the format, as described below. The **bodyDefTables** field defines how the IndexedFaceSet child of **bodySceneGraph** Segment Node is modified based on sets of BAPs. By means of **bodyDefTables**, the skin or clothes surface geometry of the model can be deformed. The **bodyDefTables** field is defined below.

bodyDefTables defines the behavior of the deformation of the body based on BAP values. See 9.4.2.21.

bodySceneGraph defines the joint center, default geometry, and texture of the body. See Annex M.

bodySegmentConnectionHint contains a **BodySegmentConnectionHint** node (see 9.4.2.22).

9.4.2.18 Billboard

9.4.2.18.1 Node interface

| | | | | |
|--------------------|---------|-----------------------|---------|----|
| Billboard { | | | | |
| eventIn | MFNode | addChildren | | |
| eventIn | MFNode | removeChildren | | |
| exposedField | SFVec3f | axisOfRotation | 0, 1, 0 | |
| exposedField | MFNode | children | | [] |
| } | | | | |

NOTE — For the binary encoding of this node see Annex [H.1.13](#).

9.4.2.18.2 Functionality and semantics

The semantics of the **Billboard** node are specified in ISO/IEC 14772-1:1998, subclause 6.6. ISO/IEC 14496-1 does not support the bounding box parameters (**bboxCenter** and **bboxSize**).

9.4.2.19 Bitmap

9.4.2.19.1 Node interface

| | | | | |
|-----------------|---------|--------------|--------|--|
| Bitmap { | | | | |
| exposedField | SFVec2f | scale | -1, -1 | |
| } | | | | |

NOTE — For the binary encoding of this node see Annex [H.1.14](#).

9.4.2.19.2 Functionality and semantics

Bitmap is a geometry node centered at (0,0) in the local coordinate system, to be placed in the geometry field of a **Shape** node. It is a screen-aligned rectangle, which means that the surface normal of this rectangle will always be in the same direction as the screen surface normal, namely straight out to the viewer. It is for example not possible to view the **Bitmap** under an angle from the side. **Bitmap** has the dimensions of the texture that is mapped onto it, as specified in the **Appearance** node of its parent **Shape** node. However, the effective geometry of **Bitmap** is defined by the non-transparent pixels of the image or video that is mapped onto it. When no scaling is specified, a trivial texture-mapping (pixel copying) is performed.

The **scale** field specifies a scaling of the geometry in the x and y dimensions, respectively. The **scale** values shall be strictly positive or equal to -1. A **scale** value of -1 indicates that no scaling shall be applied in the relevant dimension. The special case where both scale dimensions are -1 indicates that the natural dimensions of the texture that is mapped onto the **Bitmap** shall be used.

Bitmap shall not be rotated but may be subject to translation.

Geometry sensors shall respond to the effective geometry of the **Bitmap**, which is defined by the non-transparent pixels of the texture that is mapped onto it.

Example — To specify semi-transparent video:

```

Shape {
    appearance Appearance {
        texture MovieTexture { // visual object
            ...
        }
        material Material2D {
            transparency 0.5 // semi-transparent
        }
    }
    geometry Bitmap {}
}

```

9.4.2.20 Body

9.4.2.20.1 Node interface

| | | | |
|---------------------|---------------------|------|--|
| Body { | | | |
| exposedField SFNode | bdp | NULL | |
| exposedField SFNode | bap | NULL | |
| exposedField MFNode | renderedBody | [] | |
| } | | | |

NOTE - For the binary encoding of this node see Annex [H.3.6](#).

9.4.2.20.2 Functionality and semantics

The **Body** node organizes definition and animation of a body. The **bap** field shall be always specified. Defining the particular look of a body by means of downloading the position of joint centers or an entire model is optional. If the **bdp** field is NULL, i.e., the BDP node is not specified, the default body model of the decoder is used.

bdp contains a **BDP** node.

bap contains a **BAP** node.

renderedBody is the scene graph of the body after it is rendered (all BAP parameters are applied).

If the **bdp** field of the **Body** node is [] and the **Body** node is a child of a **Group** node that only has one **Face** and one **Body** node, then the **Body** node is associated to that **Face** node.

9.4.2.21 BodyDefTable

9.4.2.21.1 Node interface

| | | | |
|-----------------------|-------------------------------|------|--|
| BodyDefTable { | | | |
| exposedField SFString | bodySceneGraphNodeName | NULL | |
| exposedField MFInt32 | bapIDs | [] | |
| exposedField MFInt32 | vertexIds | [] | |
| exposedField MFInt32 | bapCombinations | [] | |
| exposedField MFVec3f | displacements | [] | |
| exposedField SFI32 | numInterpolateKeys | 2 | |
| } | | | |

NOTE - For the binary encoding of this node see Annex [H.3.7](#).

9.4.2.21.2 Functionality and semantics

Defines the behavior of body animation parameters (BAPs) on a downloaded bodySceneGraph by specifying displacement vectors of moved vertices inside **IndexedFaceSet** objects as a function of a combination of BAPs. The listed vertices typically represent the deformable body skin surface, or clothe animation for the body.

The **BodyDefTable** node is transmitted directly after the BIFS bitstream of the BDP node. There is no limit on the number of **BodyDefTable** nodes transmitted for one body. A vertex can be listed on more than one **BodyDefTable** nodes. A BAP can be listed on more than one **BodyDefTable** nodes. In this case, the displacements of the same vertex from various BodyDefTable nodes are added to obtain resulting displacement.

Each **BodyDefTable** node contains a list of BAPs, and a list of vertices in the **bodySceneGraph** that are normally affected by these BAPs (for example, the upper and lower arm skin vertices are affected by the elbow joints).

Detailed semantics:

Contains a **BodySegmentConnectionHint** node contains the name of the segment containing an IndexedFaceSet node for which the deformation is defined. This node shall be part of the bodySceneGraph as defined in the BDP node. This node will be contained in the children field of the Segment node.

bapIDs contains the BAP indices, for which the deformation behavior is defined in the bodySceneGraphNodeName field. (Any number of BAPs can be listed in this field). The BAP IDs are defined in the Visual FPDAM1. The values between [1-186] denote the standard BAPs, the values [187-296] denote the user-defined. Other values are undefined.

vertexIDs contains a list of indices into the Coordinate node of the IndexedFaceSet node specified by the child of node with name bodySceneGraphNodeName.

bapCombinations contains a list of interval borders for BAP values, i.e. a list of possible BAP combinations, for the BAPs listed in the bapIDs field. The number of values in this field shall be an integer multiple of BAP indices as given in the bapIDs field. The entries shall be ordered as follows: first, the BAP combinations with the first listed BAP having lowest values are listed. If there are more than one entry with the same value for the first BAP, the entries are sorted considering the second listed BAP, etc.

displacements is a list of vectors; for each vertex indexed in the vertexIDs field, the displacement vectors are given for the BAP combinations defined in the bapCombinations field. There must be exactly (num(VertexIDs)*num(bapCombinations)/num(bapIDs)) values in this field.

numInterpolateKeys is the number of BAP keys for interpolation, as defined below. The allowed values are 1-5.

In most cases, the list of BAPs in the **bapIDs** field will be the related BAPs (for example, the shoulder BAPs will typically be listed in the same **BodyDefTable** node). During animation, when the decoder receives a list of BAPs, which affects one or more **IndexedFaceSets** of the body model, it finds the associated BAP combination entries in the **BodyDefTable** nodes, and displaces the vertices from the original surface, with the vector specified by the **displacement** field.

Example:

```
BodyDefTable {
    bodySceneGraphNodeName      "l_forearm"
    bapIDs                  [ 38, 40 ]
    vertexIDs                [ 50, 51, 52 ]
    bapCombinations [ 0, 0, 0, 100, 0, 200,
                        100, 0, 100, 100, 100, 200,
                        200, 0, 200, 100, 200, 200]
    displacements   [ 1 0 0,0.9 0 0,5.0 0.1 0.1,
                      0 0.3 0.3,0.4 0 0,5.0 0 0.1,
                      0.5 0.6 0,0.9 0 0,5 0.7 0.1]
}
```

This **BodyDefTable** node defines the deformation of the forearm based on the combination of l_elbow_flexion and l_elbow_twisting BAPs. The vertices with indices 50,51,52 on surface l_forearm are deformed. The displacements for vertex 50 are: (1 0 0), (0 0.3 0.3) and (0.5 0.6 0) for the BAP l_elbow_flexion and l_elbow_twisting combinations (0 0) (0 100) (0 200), respectively.

The number of entries in the **displacements** field is calculated as:

$$\text{Ndisplacements} = \text{NbapCombinations} * \text{NvertexIds}$$

where Nm represents the number of entries in node m.

$$\text{NbapCombinations} = O(\text{NbapIDs}, \text{Nkey_postures})$$

Any number of BAPs can be listed in one table, and a number of BodyDefTable nodes can be used for the same bodySceneGraphNodeName.

Interpolation

When the current BAP set for one frame does not contain the bapCombinations as listed in the **BodyDefTable** node, the entries in this node need to be interpolated to obtain the deformations. (For example, let the deformation of the right forearm be defined by BAPs 39 and 41 (right_elbow_flexion and right_elbow_twisting). Let the bapCombination entries in the table be (0,0), (0,10000), (10000,0). Then, when a BAP39-BAP41 combination of (5000,5000) is received, the displacements for the frame should be interpolated from the listed BAP values.)

Given several BAP keys $P_1, P_2, P_3, \dots, P_n$ computing linear interpolation at BAP point P . n represents the **numInterpolateKeys** field in the **BodyDefTable** node.

Let $d_1, d_2, d_3 \dots d_n$ be respective distances from P to keys.

Let $v_1, v_2, v_3 \dots v_n$ be tabular displacement values of a vertex at the keys.

For any key P_i , the deformation contributed by P_i should be *inversely* proportional to distance d_i from point P . Let this proportionality factor be f_i .

$$\text{Thus } DEF_i \text{ (deformation due to } P_i) = f_i * v_i$$

$$DEF \text{ (Total deformation at } P) = f_1 * v_1 + f_2 * v_2 + \dots + f_n * v_n$$

With the condition that $f_1 + f_2 + \dots + f_n = 1.0$

computing f_i is obtained in the following way:

Let total distance $D = d_1 + d_2 + \dots + d_n$

$$f_i = (1 - d_i/D)/(n-1)$$

calculation:

First compute DIRECT proportionality factors t_i

$$t_1 = d_1/D, t_2 = d_2/D, \dots, t_n = d_n/D$$

Now $t_1 + t_2 + \dots + t_n = 1.0$

If we take deformation contribution by P_i as $DEF_i = t_i v_i$

then keys closest to point p contribute least. To have the opposite effect we get inverse proportionality by replacing t_i 's

$$t_i \leftarrow (1 - t_i) \leftarrow (1 - d_i/D)$$

$$t_1 \leftarrow 1 - d_1/D, t_2 \leftarrow 1 - d_2/D, \dots, t_n \leftarrow 1 - d_n/D$$

But now

$$t_1 + t_2 + \dots + t_n = n - 1$$

To make right hand side 1.0, we divide by $n-1$. Thus the final factor f_i

$$f_i = t_i/(n-1) = (1 - d_i/D)/(n-1)$$

Note that the default body posture is defined where all BAPs are 0 and the displacements are 0. This default posture shall not be used as a BAP combinations entry for interpolation, unless it is defined explicitly as BAP combinations in the **BodyDefTable**.

9.4.2.22 BodySegmentConnectionHint

9.4.2.22.1 Node Interface

```
BodySegmentConnectionHint {
    exposedField      SFString   firstSegmentNodeName      NULL
    exposedField      SFString   secondSegmentNodeName    NULL
    exposedField      MFInt32    firstVertexIdList      []
    exposedField      MFInt32    secondVertexIdList    []
}
```

NOTE - For the binary encoding of this node see Annex [H.3.8](#).

9.4.2.22.2 Functionality and semantics

Defines the connection information of segments as a hint for maintaining connected surfaces. Typically, two segments connected by a joint might require listing corresponding vertices in both segments, as a hint to the **BodyDefTable** interpreter to remove holes.

The **BodySegmentConnectionHint** node is transmitted after the BIFS bitstream of **BDP** and **BodyDefTable** nodes. There is no limit on the number of **BodySegmentConnectionHint** nodes transmitted for one body. This node is a hint to the BDP interpreter; it is not required to use this node.

Each **BodySegmentConnectionHint** node contains two segments, a list of vertex ids in the two segments that need to be connected to each other for smooth rendering (for example, vertices near the elbow joint can be listed).

Detailed Semantics:

firstSegmentNodeName is the name of the segment containing the first **IndexedFaceSet** node. This node shall be part of the bodySceneGraph as defined in the **BDP** node. This node will be contained in the children field of the Segment node.

secondSegmentNodeName is the name of the segment containing the second **IndexedFaceSet** node. This node shall be part of the bodySceneGraph as defined in the **BDP** node. This node will be contained in the children field of Segment node.

firstVertexIdList is a list of indices into the Coordinate node of the first **IndexedFaceSet** node specified by **firstSegmentNodeName**.

secondVertexIdList is a list of indices into the Coordinate node of the second **IndexedFaceSet** node specified by **secondSegmentNodeName**.

The number of entries in **firstVertexIdList** and **secondVertexIdList** fields has to be the same. The corresponding vertex ids should be in the same sequence in both fields.

During animation, when the decoder displaces vertices from the original surfaces based on the vectors specified by **BodyDefTable** nodes, it can use the **BodySegmentConnectionHint** node to connect the two surfaces. If two corresponding vertices are not displaced with the same amount due to different **BodyDefTable** displacement values or due to numerical error, then the decoder can take the average displacement of two corresponding vertices.

9.4.2.23 Box

9.4.2.23.1 Node interface

```
Box {
    field      SFVec3f      size          2, 2, 2
}
```

NOTE — For the binary encoding of this node see Annex [H.1.15](#).

9.4.2.23.2 Functionality and semantics

The semantics of the **Box** node are specified in ISO/IEC 14772-1:1998, subclause 6.7.

9.4.2.24 Circle

9.4.2.24.1 Node interface

```
Circle {
    exposedField  SFFloat      radius        1.0
}
```

NOTE — For the binary encoding of this node see Annex [H.1.16](#).

9.4.2.24.2 Functionality and semantics

This node specifies a circle centred at (0,0) in the local coordinate system. The **radius** field specifies the radius of the circle and shall be greater than 0.

9.4.2.25 Collision

9.4.2.25.1 Node interface

```
Collision {
    eventIn       MFNode      addChildren
    eventIn       MFNode      removeChildren
    exposedField  MFNode      children          []
    exposedField  SFBool      collide         TRUE
    field         SFNode      proxy           NULL
    eventOut      SFTime      collideTime
}
```

NOTE — For the binary encoding of this node see Annex [H.1.17](#).

9.4.2.25.2 Functionality and semantics

The semantics of the Collision node are specified in ISO/IEC 14772-1:1998, subclause 6.8. ISO/IEC 14496-1 does not support the bounding box parameters (bboxCenter and bboxSize).

9.4.2.26 Color

9.4.2.26.1 Node interface

```
Color {
    exposedField  MFColor     color          []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.18](#).

9.4.2.26.2 Functionality and semantics

The semantics of the **Color** node are specified in ISO/IEC 14772-1:1998, subclause 6.9.

9.4.2.27 ColorInterpolator

9.4.2.27.1 Node interface

```
ColorInterpolator {
    eventIn      SFFloat      set_fraction
    exposedField MFFloat      key
    exposedField MFColor      keyValue
    eventOut     SFColor      value_changed
}
}
```

NOTE — For the binary encoding of this node see Annex [H.1.19](#).

9.4.2.27.2 Functionality and semantics

The semantics of the **ColorInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.10.

9.4.2.28 CompositeTexture2D

9.4.2.28.1 Node interface

```
CompositeTexture2D {
    eventIn      MFNode       addChild
    eventIn      MFNode       removeChildren
    exposedField MFNode      children
    exposedField SFInt32     pixelWidth
    exposedField SFInt32     pixelHeight
    exposedField SFNode      background
    exposedField SFNode      viewport
}
}
```

NOTE — For the binary encoding of this node see Annex [H.1.20](#).

9.4.2.28.2 Functionality and semantics

The **CompositeTexture2D** node represents a texture that is composed of a 2D scene, which may be mapped onto another object.

This node may only be used as the texture field of an **Appearance** node. All behaviors and user interaction are enabled when using a **CompositeTexture2D**.

The **addChild** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChildren** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** field contains a list of 2D children nodes that define the 2D scene that is to form the texture map.

The **pixelWidth** and **pixelHeight** fields specify the ideal size in pixels of this map. The default values result in an undefined size being used. This is a hint for the content creator to define the quality of the texture mapping.

The semantics of the **background** and **viewport** fields are identical to the semantics of the **Layer2D** (see 9.4.2.63) fields of the same name.



Figure 16 - A CompositeTexture2D example. The 2D scene is projected onto the 3D cube.

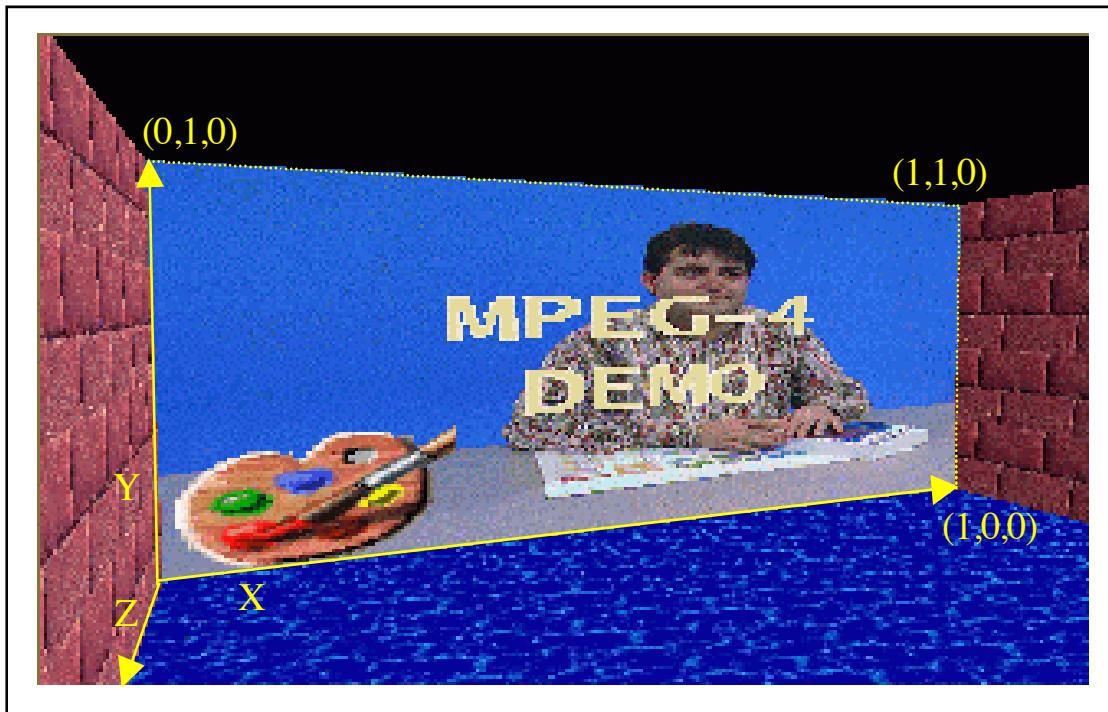


Figure 17 - A CompositeTexture2D example.

Here the 2D scene as defined in Figure 16 composed of an image, a logo, and a text, is textured on a rectangle *n* in the local X,Y plane of the back wall. A similar effect may be obtained by simply placing the 2D objects in the (3D) **Transform**. However, **CompositeTexture2D** and **CompositeTexture3D** shall be used when mapping onto non-flat geometries.

9.4.2.29 CompositeTexture3D

9.4.2.29.1 Node interface

CompositeTexture3D {

| | |
|--------------|--------|
| eventIn | MFNode |
| eventIn | MFNode |
| exposedField | MFNode |

| |
|-----------------------|
| addChildren |
| removeChildren |
| children |

[]

```

exposedField SFInt32    pixelWidth          -1
exposedField SFInt32    pixelHeight        -1
exposedField SFNode     background
exposedField SFNode     fog
exposedField SFNode     navigationInfo
exposedField SFNode     viewpoint
}

```

NOTE — For the binary encoding of this node see Annex [H.1.21](#).

9.4.2.29.2 Functionality and semantics

The **CompositeTexture3D** node represents a texture mapped onto a 3D object that is composed of a 3D scene.

Behaviors and user interaction are enabled when using a **CompositeTexture3D**. However, the standard user navigation on the textured scene is disabled. Instead, sensors contained in the scene which forms the **CompositeTexture3D** may be used to define behaviours. This node may only be used as a **texture** field of an **Appearance** node.

The **addChild** eventIn specifies a list of nodes that shall be added to the **children** field.

The **removeChild** eventIn specifies a list of nodes that shall be removed from the **children** field.

The **children** field is the list of 3D children nodes that define the 3D scene that forms the texture map.

The **pixelWidth** and **pixelHeight** fields specify the ideal size in pixels of this map. The default values result in an undefined size being used. This is a hint for the content creator to define the quality of the texture mapping.

The **background**, **fog**, **navigationInfo** and **viewpoint** fields represent the current values of the bindable children nodes used in the 3D scene. This node may only be used as the **texture** field of an **Appearance** node. All behaviors and user interaction are enabled when using a **CompositeTexture2D**.

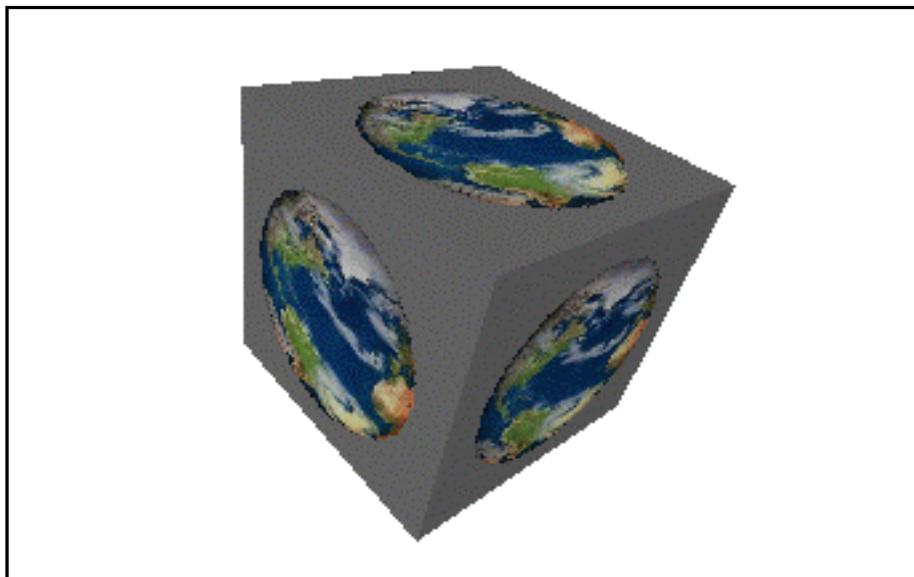


Figure 18 - CompositeTexture3D example. The 3D view of the earth is projected onto the 3D cube

9.4.2.30 Conditional

9.4.2.30.1 Node interface

```
Conditional {
    eventIn     SFBool      activate
    eventIn     SFBool      reverseActivate
    exposedField SFString   buffer
    eventOut    SFBool      isActive
}
    """"
```

NOTE — For the binary encoding of this node see Annex [H.1.22](#).

9.4.2.30.2 Functionality and semantics

The **Conditional** node interprets a buffered bit string of BIFS-Commands when it is activated. This allows events to trigger node updates, deletions, and other modifications to the scene. The buffered bit string is interpreted as if it had just been received.

Upon reception of either an SFBool event of value TRUE on the **activate** eventIn, or an SFBool event of value FALSE on the **reverseActivate** eventIn, the contents of the buffer field shall be interpreted as a BIFS CommandFrame (see 9.3.6.2). These updates are not time-stamped; they are executed at the time of the event, assuming a zero-decoding time.

EXAMPLE — A typical use of this node is for the implementation of the action of a button. The button geometry is enclosed in a grouping node which also contains a **TouchSensor** node. The **isActive** eventOut of the **TouchSensor** is routed to the **activate** eventIn of **Conditional** C1 and to the **reverseActivate** eventIn of **Conditional** C2; C1 then implements the “mouse-down” action and C2 implements the “mouse-up” action.

9.4.2.31 Cone

9.4.2.31.1 Node interface

```
Cone {
    field       SFFloat    bottomRadius        1.0
    field       SFFloat    height              2.0
    field       SFBool     side                TRUE
    field       SFBool     bottom              TRUE
}
    """"
```

NOTE — For the binary encoding of this node see Annex [H.1.23](#).

9.4.2.31.2 Functionality and semantics

The semantics of the **Cone** node are specified in ISO/IEC 14772-1:1998, subclause 6.11.

9.4.2.32 Coordinate

9.4.2.32.1 Node interface

```
Coordinate {
    exposedField MFVec3f   point           []
}
    """"
```

NOTE — For the binary encoding of this node see Annex [H.1.24](#).

9.4.2.32.2 Functionality and semantics

The semantics of the **Coordinate** node are specified in ISO/IEC 14772-1:1998, subclause 6.12.

9.4.2.33 Coordinate2D

9.4.2.33.1 Node interface

```
Coordinate2D {
    exposedField MFVec2f      point          []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.25](#).

9.4.2.33.2 Functionality and semantics

This node defines a set of 2D coordinates to be used in the **coord** field of geometry nodes.

The **point** field contains a list of points in the 2D coordinate space (see 9.2.2.2).

9.4.2.34 CoordinateInterpolator

9.4.2.34.1 Node interface

```
CoordinateInterpolator {
    eventIn     SFFloat    set_fraction
    exposedField MFFloat   key
    exposedField MFVec3f  keyValue
    eventOut    MFVec3f   value_changed
}
```

NOTE — For the binary encoding of this node see Annex [H.1.26](#).

9.4.2.34.2 Functionality and semantics

The semantics of the **CoordinateInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.13.

9.4.2.35 CoordinateInterpolator2D

9.4.2.35.1 Node interface

```
CoordinateInterpolator2D {
    eventIn     SFFloat    set_fraction
    exposedField MFFloat   key
    exposedField MFVec2f  keyValue
    eventOut    MFVec2f   value_changed
}
```

NOTE — For the binary encoding of this node see Annex [H.1.27](#).

9.4.2.35.2 Functionality and semantics

CoordinateInterpolator2D is the 2D equivalent of **CoordinateInterpolator** (see 9.4.2.34).

9.4.2.36 Curve2D

9.4.2.36.1 Node interface

```
Curve2D {
    exposedField SFNode    point          NULL
    exposedField SFInt32   fineness
    exposedField MFInt32   type          []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.28](#).

9.4.2.36.2 Functionality and semantics

This node is used to describe the Bezier approximation of a polygon in the scene at an arbitrary level of precision. It behaves as other “lines”, which means it is sensitive to modifications of line width and “dotted-ness”, and can be filled or not.

The given parameters are a control polygon and a parameter setting the quality of approximation of the curve. Internally, another polygon of fineness points is computed on the basis of the control polygon. The coordinates of that internal polygon are given by the following formula:

$$x[j] = \sum_{i=0}^n xc[i] \times \frac{(n-1)!}{i!(n-1-i)!} \times \left(\frac{j}{f}\right)^i \times \left(1 - \frac{j}{f}\right)^{n-1-i},$$

where $x[j]$ is the j^{th} x coordinate of the internal polygon, n is the number of points in the control polygon, $xc[i]$ is the i^{th} x coordinate of the control polygon and f is short for the above fineness parameter which is also the number of points in the internal polygon. A similar formula yields the y coordinates.

The **point** field shall list the vertices of the control polygon.

The **fineness** parameter is an SFFloat value that indicates how finely to tessellate the Bezier curves. A value of 1 means that the curve shall be fine enough that no edges are visible. A value of 0 indicates that a straight line shall be drawn between the two points of the curve. The default value of 0.5 gives an intermediate level of smoothness. The amount of tessellation may be adjusted according to scale of the shape, making it possible to avoid visible edges appearing when the shape is zoomed. When the field **type** is specified, the above functionality is extended as follows: the curve is now defined piecewise either with the above equation or as straight segments or as non-segments, depending on the values in **type**. The **point** field is now taken to contain all key-points (points where the curve passes) and control-points (points defining the aspect of the curve around them). The values in the **type** field define the semantics of the elements of **point**.

The **point** field contains a **Coordinate2D** field with the list of points. If the **type** field is non-empty, then it shall contain tokens indicating how the point list is to be interpreted, according to the following algorithm (expressed in pseudo-code):

```

SFInt32 i      = 0;
SFInt32 j      = 0;
SFVec2f cur    = point[i++];
SFVec2f first  = cur;
SFVec2f curctl;

while (i < point.length)
    SFInt32 t = 0;
    if (type.length > j) t = type[j++];

    switch(t) {
        case 0: // move, use 1 point
            if (is_filled) draw_line(cur, point[i]);
            cur = point[i];
            i++;
            break;

        case 1: // line, use 1 point
            draw_line(cur, point[i]);
            cur = point[i];
            i++;
            break;

        case 2: // bezier curve, use 3 points
            draw_curve(cur, point[i], point[i+1], point[i+2]);
            cur = point[i+2];
            curctl = point[i+1];
            i += 3;
            break;

        case 3: // tangent curve, use 2 points
    }
}

```

```

SFVec2f tanctl;
tanctl.x = 2*cur.x - curctl.x;
tanctl.y = 2*cur.y - curctl.y;
draw_curve(cur, tanctl, point[i], point[i+1]);
cur = point[i+1];
curctl = point[i];
i += 2;
break;
}
}
if (is_filled) draw_line(cur, first);

```

In the above pseudo-code, `draw_line(a,b)` draws a line from a to b and `draw_curve(a,b,c,d)` draws a Bezier curve from a to d, using b as the control point for a and c as the control point for d. Note that, because of the move command (`type = 0`) multiple disjoint segments are possible. In the case of a filled shape, each segment is closed by drawing a straight line from the last point in the segment to the first. Shapes are filled using the odd-even winding fill rule. If one segment is contained within another, the inside of the inner shape is not filled, allowing shapes with holes.

The first coordinate pair in `point` is the starting point of the curve. The first value in `type` describes the treatment to be applied to the subsequent coordinate pairs. At any time, a value in `type` describes the characteristics of the next curve segment. If **P** is the starting point or the last point of the previous segment of the curve; **N** the ending point of the current curve segment; **C₁** the control point on the side of **P** and **C₂** the control point on the side of **N**.

The permitted values of `type` are:

- 0 = MoveTo: One coordinate pair in the `point` list is consumed, defining **N**. **P** ends the curve. The curve shall start again at **N**. Sequences of two or more MoveTos shall not occur. MoveTo shall not occur as the first element in `type`.
- 1 = LineTo: One coordinate pair in the `point` list is consumed, defining **N**. A straight line is drawn from **P** to **N**.
- 2 = CurveTo: Three coordinate pairs in the `point` list are consumed, defining **C₁**, **C₂** and **N** respectively. The first coordinate pair specifies the control point the start of this curve segment (**C₁**), the second specifies the control point for end of the curve segment (**C₂**) and the third specifies the ending point of the curve segment (**N**).
- 3 = NextCurveto: Two coordinate pairs in the `point` list are consumed, defining **C₂** and **N** in this order. The first coordinate pair specifies the control point for the end of the curve segment (**C₂**), and the second specifies the ending point of the curve segment (**N**). The control point **C₁** for the start of the curve segment is derived from the previous control point. If the previous segment was formed with CurveTo or NextCurveTo, the start control point **C₁** is symmetrical to the end control point **C₂** of the previous curve segment with respect to point **P**. This control type shall not occur immediately following a MoveTo or LineTo.

The formula for obtaining the coordinates of **C₁** in the case of a NextCurveTo is:

$$\mathbf{C}_{1x} = 2.P_x - \mathbf{C}'_{2x} \text{ and } \mathbf{C}_{1y} = 2.P_y - \mathbf{C}'_{2y}$$

The first point in `point`, as the first point in the curve, is implicitly a MoveTo.

For CurveTo and NextCurveTo, the piece of curve is constructed using the above formula as applied to a polygon constructed from four points, that is the starting point **P**, the first control point **C₁**, the second control point **C₂** and the end point **N**, which is the next point in the point list.

The curve shall be continuous except at points tagged with MoveTo. The tangent of the curve is only continuous at points tagged with NextCurveTo, or at points where the previous second control point **C₂**, the key point **P** and the next first control point **C₁** are aligned.

If there are more values in `point` than specified by `type`, then the unused points shall describe a curve as if no `type` was defined.

EXAMPLE —

```
geometry Curve2D {
    point Coordinate2D {
        points [ 0 0 0 100 200 100 200 200 210 200 220 200 ]
    }
    type [ 2 0 1 ]
}
```

The first segment of curve starts at 0,0 goes to 200,200 and control points are 0,100 and 200,100. The Bezier curve drawn is the one with the polygon [0 0 0 100 200 100 200 200] (represented in dotted gray) when types=null, with the same fineness. When types is specified, the fineness parameter is applied to each curve segment. Then we have a "move to", from 200,200 to 210,200. Then we have a "line to", from 210,200 to 220,200 (small segment in upper right corner).

In Figure 19, the curve is drawn in wide black, and the control polygon is drawn in dotted gray. The curve has two connex components.

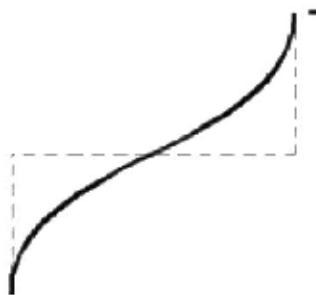


Figure 19 - Curve node example

9.4.2.37 Cylinder

9.4.2.37.1 Node interface

```
Cylinder {
    field      SFBool    bottom      TRUE
    field      SFFloat   height     2.0
    field      SFFloat   radius     1.0
    field      SFBool    side       TRUE
    field      SFBool    top        TRUE
}
```

NOTE — For the binary encoding of this node see Annex [H.1.29](#).

9.4.2.37.2 Functionality and semantics

The semantics of the **Cylinder** node are specified in ISO/IEC 14772-1:1998, subclause 6.14.

9.4.2.38 CylinderSensor

9.4.2.38.1 Node interface

```
CylinderSensor {
    exposedField SFBool    autoOffset  TRUE
    exposedField SFFloat   diskAngle   0.262
    exposedField SFBool    enabled     TRUE
    exposedField SFFloat   maxAngle   -1.0
    exposedField SFFloat   minAngle   0.0
    exposedField SFFloat   offset     0.0
    eventOut     SFBool    isActive
    eventOut     SFRotation rotation_changed
    eventOut     SFVec3f   trackPoint_changed
}
```

NOTE — For the binary encoding of this node see Annex [H.1.30](#).

9.4.2.38.2 Functionality and semantics

The semantics of the **CylinderSensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.15.

9.4.2.39 DirectiveSound

9.4.2.39.1 Node interface

DirectiveSound {

| | | | |
|--------------|---------|-----------------------------|---------|
| field | MFFloat | angles | 0 |
| field | MFFloat | directivity | 1 |
| field | MFFloat | frequency | [] |
| field | SFFloat | speedOfSound | 340 |
| field | SFFloat | distance | 100 |
| field | SFBool | useAirabs | FALSE |
| exposedField | SFVec3f | direction | 0, 0, 1 |
| exposedField | SFFloat | intensity | 1 |
| exposedField | SFVec3f | location | 0, 0, 0 |
| exposedField | SFNode | source | NULL |
| exposedField | SFNode | perceptualParameters | NULL |
| exposedField | SFBool | roomEffect | FALSE |
| exposedField | SFBool | spatialize | TRUE |

}

NOTE - For the binary encoding of this node see Annex [H.3.9](#).

9.4.2.39.2 Functionality and semantics

The purpose of the **DirectiveSound** node is to obtain sound source directivity which is characteristic to the sound source present in a 3-D scene. It is also needed for rendering of the acoustic response of the virtual environment. The modeling of sound propagation from the source to the listening point includes distance dependent attenuation, propagation delay between the source and the listener, and modeling of sound reflections, transmission through objects, and reverberation. Two different rendering schemes are applied to **DirectiveSound** depending on the value of **perceptualParameters** field. If this field is NULL, the *physical* approach is applied, and if it contains a **PerceptualParameters** node, the *perceptual* approach is applied (see [9.2.2.13.4](#)).

DirectiveSound is rendered in a specified area in a 3-D scene. The **distance** field specifies the radius of a spherical region around the source where the sound is audible to the user. Additionally, in the physical approach, a 3-D rectangular region specified in the **AcousticScene** nodes specify areas in the scene where the sound is audible when the **DirectiveSound** and the **Viewpoint** or **ListeningPoint** are both inside that area.

The direction dependent sound radiation properties of the sound source is defined in the **directivity** field of the node for an arbitrary number of angles given in the **angles** field with respect to the main direction axis (defined in the **direction** field) to the back of the sound source.

The **angles** field specifies the angles between the direction vector of the source and the vector between the sound source location and the listener (**Viewpoint** or **ListeningPoint**) in radians, at which the directivity parameters apply.

The semantics of the **directivity** field is defined in two different ways depending on the value of the **frequency** field, which in one case is an empty vector [], and in the other case is a MFField containing a set of frequencies at which digital filter magnitude response gains are valid. Both ways are allowed in the physical approach, but in the perceptual approach only one is allowed.

frequency field defines the frequencies at which the directivity gains are valid (similarly as **refFrequency** and **transFrequency** for **reffunc** and **transfunc** in **AcousticMaterial**, see [9.4.2.1](#)).

There are two different ways of defining directivity for a sound source. If the **frequency** field is [], the parameters in the **directivity** field are considered as a set of digital filter coefficients, and if this field is different from [] its semantics are as explained above.

In the *physical approach* both ways of defining directivity are possible. If **frequency** is equal to [], the directivity can be defined as a single scale factor associated to each given azimuth angle, or as frequency modifying digital filter parameters. In the latter case, the general form for the field is:

$[b_{\alpha 0,0}, b_{\alpha 0,1}, b_{\alpha 0,2}, \dots, b_{\alpha 0,M}, a_{\alpha 0,1}, a_{\alpha 0,2}, \dots, a_{\alpha 0,M}, b_{\alpha 1,0}, b_{\alpha 1,1}, b_{\alpha 1,2}, \dots, b_{\alpha 1,M}, a_{\alpha 1,1}, a_{\alpha 1,2}, \dots, a_{\alpha 1,M}, \dots]$

where $\alpha 0$ is the first specified angle in the **angles** field, $\alpha 1$ is the second angle etc., and M is the order of the digital filter. If the directivity is specified as gains, the form of the field is:

$[b_{\alpha 0}, b_{\alpha 1}, \dots, b_{\alpha K}]$

where K is the number of specified angles.

These coefficients represent a digital filter, whose system function $H(z)$ is represented in the z -domain as a division of the z -transform of the output sequence $Y(z)$ with the z -transform of the input sequence $X(z)$:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^M b_k z^{-k}}{1 + \sum_{k=1}^M a_k z^{-k}}.$$

The distinction between the coefficients of different filters is obtained by dividing the length of the directivity field by the amount of specified angles (length of the **angles** field):

$$n = \frac{\text{length}(\text{directivity})}{\text{length}(\text{angles})} = 2 \cdot M + 1 = m_b + m_a,$$

where n is the number of coefficients in each filter, and M is the order of the filter, m_b is the number of b coefficients, and m_a is the number of a coefficients. Thus, the number of a coefficients is

$$m_a = \frac{n-1}{2},$$

and the number of b coefficients is

$$m_b = \frac{n-1}{2} + 1.$$

If the first angle $\alpha 0 > 0$, the directivity at angles $0 < \alpha < \alpha 0$ is the same as at $\alpha 0$, and if the last specified angle αM is smaller than π , the directivity at angles $\alpha M < \alpha < \pi$ is the same as at αM .

The second way of defining directivity is to give a set of gains in **directivity** field at frequencies defined in **frequency** field. This scheme can be used both in perceptual and in the physical approaches.

The source directivity is defined as gain factors at specified frequencies for a set of reference angles (specified in the **angles** field). In this approach, the general form for the **directivity** field is then:

$[\text{gain}^0_0, \text{gain}^0_1, \dots, \text{gain}^0_{n_f-1}, \text{gain}^1_0, \text{gain}^1_1, \dots, \text{gain}^1_{n_f-1}, \dots, \text{gain}^{n_a-1}_0, \text{gain}^{n_a-1}_1, \dots, \text{gain}^{n_a-1}_{n_f-1}]$.

Where, n_f is the number of reference frequencies, and freq_j is the j^{th} reference frequency

gain^i_j is the gain for the i^{th} reference angle and the j^{th} reference frequency, and n_a is the length of the **angles** field.

The form of the **frequency** field is then:

$[\text{freq}_0, \text{freq}_1, \dots, \text{freq}_{n_f-1}]$

The number of reference angles is the same as the length of the **angles** field, and the number of reference frequencies is the same as the length of **frequency** field. An example of **directivity** is given below:

```
[0.9,0.85,0.7,0.6,0.55,
 0.85,0.75,0.6,0.5,0.4,
 0.8,0.65,0.5,0.4,0.3,
 0.5,0.45,0.3,0.2,0.1]
```

and an example of **frequency** in this case is:

```
[250, 500, 1000, 2000, 4000]
```

Axisymmetry is assumed, so only angles from 0 to π radians are needed to fully define frequency-dependent directivity.

If not specified in the node, the default filtering at 0 rad is the same as for the first specified angle (α_0). If not specified in the node, the default gain at π rad is gain^{na-1} for the j_{th} frequency.

If not specified in the node, the default gain at 0 Hz is gain^i_0 for the i_{th} angle.

By default, the gain for frequencies above f_{nf-1} is gain^i_{nf-1} for the i_{th} angle.

The directivity filtering is defined by these gains at the specified frequencies.

In both physical and the perceptual approaches the output of directivity filtering between the specified angles should perform an interpolated result of the magnitude responses of the specified directivities. This can be a result of, e.g., crossfading between different filter outputs, or suitable interpolation of coefficients of the filters.

The **direction** field specifies the direction the **DirectiveSound** node is facing. This field is used in the directivity computation of the sound source, i.e., it defines the direction of the angle of 0 (rad) in the directivity field.

The **intensity** field specifies the gain the original sound stream is multiplied with.

The **speedOfSound** field is used to enable control of the pre-delay added to the sound depending on the distance between the source and the listener. With other values of **speedOfSound** than 0 the delay is computed as:

$$d = \frac{dist}{speedOfSound},$$

where *dist* is the current distance between the source and the listener in meters, and *speedOfSound* is the value of **speedOfSound** field in meters.

speedOfSound field also defines the delay of the reflections off acoustic surfaces in the physical approach, since they are computed according to the corresponding *image source* locations and the speed of sound. These acoustic surfaces are polygons defined in **IndexedFaceSet** nodes that have **AcousticMaterial** associated to them as their appearance (see 9.4.2.1). This field also controls the Doppler effect that is caused by the changing distance between the listening point and the listener. Thus the smaller the value of **speedOfSound** is, the stronger the Doppler effect is (pitch shift caused by the changing distance between the source and the listener). The changing delay caused by a varying distance between the source (direct sound or image source corresponding to a reflection) and the listener should always be interpolated to avoid artifacts such as clicks in the delayed sound.

The default value of **speedOfSound** is 0. With this value, and **roomEffect** = FALSE, no delay of sound propagation between the direct sound and the listener is rendered (except when there are physically rendered early reflections, see next paragraph). This enables a **DirectiveSound** node to be spatialized in a 3-D space so that the direction and attenuation of the sound are perceived according to the sound source location relative to the listener, but neither Doppler effect nor delay is implemented.

If the sound is rendered according to the physical approach, and the source and the listening point are located within an **AcousticScene** audibility region, and there are **IndexedFaceSet** surfaces with acoustic reflectivity, associated to that **AcousticScene**, and the value of **roomEffect** is TRUE, the Doppler effect and the delays of the direct sound and physical early reflections are computed according to the speed of sound in the air (340 m/s), even if this field is set to 0.

The **distance** field specifies the distance dependent attenuation of the sound. Within one meter from the source the sound is multiplied by the value of the **intensity** field before any spatial processing (directivity filtering, spatialization, or room effect). At a distance in meters given by the **distance** field, the sound has attenuated 60dB from the value within the 1-meter distance. Outside this distance from the sound source the sound is not audible. The gain function will be linearly attenuated on a dB scale between the source and the given cutoff distance. The radiation pattern defined by the **directivity** field will thus give the overall directivity, which will be uniformly attenuated as a function of distance. If, however, the **distance** field is set to 0, no distance dependent attenuation is applied.

Field **useAirabs** specifies whether the distance dependent air absorption filtering is applied to the direct sound. ISO 9613-1:1993 specifies equations for air absorption curves in different humidity and temperature conditions, and the frequency modification of the distance dependent air absorption filtering should follow one of these curves at maximum accuracy possible.

location field specifies the 3-D location of the sound source in the local coordinate system of the **DirectiveSound**.

source field allows the connection of an audio source containing the sound.

The **spatialize** field has the same semantics concerning the direct sound, as in the **Sound** node, i.e., if this flag is set to TRUE, the sound stream attached to this node should be processed so that appears to come from the direction of sound source with respect to the current direction of the viewpoint. In the case of **DirectiveSound** (physical approach), this flag is also applied to the reflections caused by acoustic surfaces (specified by **IndexedFaceSets** and **AcousticMaterials**). When **spatialize** = TRUE, also the directions of the reflections are rendered. If the value of this flag is FALSE, the sound routed through **DirectiveSound** node, or its reflections are not spatialized according to their 3-D direction of arrival at the listener.

Field **roomEffect** is used for enabling and disabling environmental spatialization of audio. This field specifies whether the environmental response (*physical* case: reflections, reverberation, sound transmission filtering when propagating through surfaces; *perceptual* case: reverberation according to the **PerceptualParameters** node) is applied to this sound node. When this flag is TRUE the **DirectiveSound** source is spatialized according to the reflections and reverberation in the virtual environment. If, like mentioned above, also the **spatialize** flag is TRUE, the directions of the physical reflections are also rendered, and if **spatialize** is FALSE (but **roomEffect** is TRUE), a monophonic room acoustic effect is produced.

9.4.2.40 DiscSensor

9.4.2.40.1 Node interface

| | | | |
|----------------------|---------------------------|--|------|
| DiscSensor { | | | |
| exposedField SFBool | autoOffset | | TRUE |
| exposedField SFBool | enabled | | TRUE |
| exposedField SFFloat | maxAngle | | -1.0 |
| exposedField SFFloat | minAngle | | -1.0 |
| exposedField SFFloat | offset | | 0.0 |
| EventOut SFBool | isActive | | |
| EventOut SFFloat | rotation_changed | | |
| EventOut SFVec2f | trackPoint_changed | | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.31](#).

9.4.2.40.2 Functionality and semantics

This sensor enables the rotation of an object in the 2D plane around an axis specified in the local coordinate system. The semantics are as similar to those for **CylinderSensor**, but restricted to a 2D case.

9.4.2.41 DirectionalLight

9.4.2.41.1 Node interface

| | | | |
|---------------------------|-------------------------|----------|--|
| DirectionalLight { | | | |
| exposedField SFFloat | ambientIntensity | 0.0 | |
| exposedField SFColor | color | 1, 1, 1 | |
| exposedField SFVec3f | direction | 0, 0, -1 | |
| exposedField SFFloat | intensity | 1.0 | |
| exposedField SFBool | on | TRUE | |

}

NOTE — For the binary encoding of this node see Annex [H.1.32](#).

9.4.2.41.2 Functionality and semantics

The semantics of the **DirectionalLight** node are specified in ISO/IEC 14772-1:1998, subclause 6.16.

9.4.2.42 ElevationGrid

9.4.2.42.1 Node interface

| | | | |
|------------------------|------------------------|------|--|
| ElevationGrid { | | | |
| EventIn MFFloat | set_height | | |
| exposedField SFNode | color | NULL | |
| exposedField SFNode | normal | NULL | |
| exposedField SFNode | texCoord | NULL | |
| Field MFFloat | height | [] | |
| Field SFBool | ccw | TRUE | |
| Field SFBool | colorPerVertex | TRUE | |
| Field SFFloat | creaseAngle | 0.0 | |
| Field SFBool | normalPerVertex | TRUE | |
| Field SFBool | solid | TRUE | |
| Field SFInt32 | xDimension | 0 | |
| Field SFFloat | xSpacing | 1.0 | |
| Field SFInt32 | zDimension | 0 | |
| Field SFFloat | zSpacing | 1.0 | |

}

NOTE — For the binary encoding of this node see Annex [H.1.33](#).

9.4.2.42.2 Functionality and semantics

The semantics of the **ElevationGrid** node are specified in ISO/IEC 14772-1:1998, subclause 6.17.

9.4.2.43 Expression

9.4.2.43.1 Node interface

| | | | |
|---------------------|------------------------------|-------|--|
| Expression { | | | |
| Field SFInt32 | expression_select1 | 0 | |
| Field SFInt32 | expression_intensity1 | 0 | |
| Field SFInt32 | expression_select2 | 0 | |
| Field SFInt32 | expression_intensity2 | 0 | |
| Field SFBool | init_face | FALSE | |
| Field SFBool | expression_def | FALSE | |

}

NOTE — For the binary encoding of this node see Annex [H.1.34](#).

9.4.2.43.2 Functionality and semantics

The **Expression** node is used to define the expression of the face as a combination of two expressions from the standard set of expressions defined ISO/IEC 14496-2, Annex C, Table C-3.

The **expression_select1** and **expression_select2** fields specify the expression types. The **expression_intensity1** and **expression_intensity2** fields specify the corresponding expression intensities.

If **init_face** is set, a neutral face may be modified before applying FAPs 1 and 3-68.

If **expression_def** is set, current FAPs are used to define an expression and store it.

9.4.2.44 Extrusion

9.4.2.44.1 Node interface

| | | | |
|--------------------|------------|-------------------------|------------------------------|
| Extrusion { | | | |
| EventIn | MFVec2f | set_crossSection | |
| EventIn | MFRotation | set_orientation | |
| EventIn | MFVec2f | set_scale | |
| EventIn | MFVec3f | set_spine | |
| Field | SFBool | beginCap | TRUE |
| Field | SFBool | ccw | TRUE |
| Field | SFBool | convex | TRUE |
| Field | SFFloat | creaseAngle | 0.0 |
| Field | MFVec2f | crossSection | 1, 1, 1, -1, -1, -1, 1, 1, 1 |
| Field | SFBool | endCap | TRUE |
| Field | MFRotation | orientation | 0, 0, 1, 0 |
| Field | MFVec2f | scale | 1, 1 |
| Field | SFBool | solid | TRUE |
| Field | MFVec3f | spine | 0, 0, 0, 0, 1, 0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.35](#).

9.4.2.44.2 Functionality and semantics

The semantics of the **Extrusion** node are specified in ISO/IEC 14772-1:1998, subclause 6.18.

9.4.2.45 Face

9.4.2.45.1 Node interface

| | | | |
|---------------|--------|---------------------|------|
| Face { | | | |
| exposedField | SFNode | fit | NULL |
| exposedField | SFNode | fdp | NULL |
| exposedField | SFNode | fap | NULL |
| exposedField | SFNode | ttsSource | NULL |
| exposedField | MFNode | renderedFace | NULL |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.36](#).

9.4.2.45.2 Functionality and semantics

The **Face** node is used to define and animate a face in the scene. In order to animate the face with a facial animation stream, it is necessary to link the **Face** node to a BIFS-Anim stream. The node shall be assigned a **nodeID**, through the DEF mechanism. Then, as for any BIFS-Anim stream, an animation mask is sent in the object descriptor of the BIFS-Anim stream (**specificInfo** field). The animation mask points to the **Face** node using its **nodeID**. The terminal shall then connect the facial animation decoder to the appropriate **Face** node.

The **FAP** field shall contain a **FAP** node, describing the facial animation parameters (FAPs). Each **Face** node shall contain a non-NULL **FAP** field.

The **FDP** field, which defines the particular look of a face by means of downloading the position of face definition points or an entire model, is optional. If the **FDP** field is not specified, the default face model of the terminal shall be used.

The **FIT** field, when specified, allows a set of FAPs to be defined in terms of another set of FAPs. When this field is non-NULL, the terminal shall use **FIT** to compute the maximal set of FAPs before using the FAPs to compute the mesh.

The **ttsSource** field shall only be non-NULL if the facial animation is to determine the facial animation parameters from an audio TTS source (see ISO/IEC 14496-3, subpart 6). In this case the **ttsSource** field shall contain an **AudioSource** node and the face shall be animated using the phonemes and bookmarks received from the TTS. See also Annex I.

renderedFace is the scene graph of the face after it is rendered (all FAP's applied).

9.4.2.46 FaceDefMesh

9.4.2.46.1 Node interface

FaceDefMesh {

| | | | |
|-------|---------|---------------------------|------|
| Field | SFNode | faceSceneGraphNode | NULL |
| Field | MFInt32 | intervalBorders | [] |
| Field | MFInt32 | coordIndex | [] |
| Field | MFVec3f | displacements | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.37](#).

9.4.2.46.2 Functionality and semantics

The **FaceDefMesh** node allows for the deformation of an **IndexedFaceSet** as a function of the amplitude of a FAP as specified in the related **FaceDefTable** node. The **FaceDefMesh** node defines the piece-wise linear motion trajectories for vertices of the **faceSceneGraphNode** field, which shall contain an **IndexedFaceSet** node. This **IndexedFaceSet** node belongs to the scenegraph of the **faceSceneGraph** field of the **FDP** node.

The **intervalBorders** field specifies interval borders for the piece-wise linear approximation in increasing order. Exactly one interval border shall have the value 0.

The **coordIndex** field shall contain a list of indices into the **Coordinate** node of the **IndexedFaceSet** node specified by the **faceSceneGraphNode** field.

For each vertex indexed in the **coordIndex** field, displacement vectors are given in the **displacements** field for the intervals defined in the **intervalBorders** field. There must be exactly $(\text{num}(\text{intervalBorders}) - 1) * \text{num}(\text{coordIndex})$ values in this field.

In most cases, the animation generated by a FAP cannot be specified by updating a **Transform** node. Thus, a deformation of an **IndexedFaceSet** node needs to be performed. In this case, the **FaceDefTables** shall define which **IndexedFaceSets** are affected by a given FAP and how the **coord** fields of these nodes are updated. This is done by means of tables.

If a FAP affects an **IndexedFaceSet**, the **FaceDefMesh** shall specify a table of the following format for this **IndexedFaceSet**:

Table 34 - Vertex displacements

| Vertex no. | 1st Interval [I₁, I₂] | 2nd Interval [I₂, I₃] | ... |
|-------------------|--|--|-----|
| Index 1 | Displacement D ₁₁ | Displacement D ₁₂ | ... |
| Index 2 | Displacement D ₂₁ | Displacement D ₂₂ | ... |
| ... | ... | ... | ... |

Exactly one interval border I_k must have the value 0:

$$[I_1, I_2], [I_2, I_3], \dots [I_{k-1}, 0], [0, I_{k+1}], [I_{k+1}, I_{k+2}], \dots [I_{max-1}, I_{max}]$$

During animation, when the terminal receives a FAP, which affects one or more **IndexedFaceSets** of the face model, it shall piece-wise linearly approximate the motion trajectory of each vertex of the affected **IndexedFaceSets** by using the appropriate table.

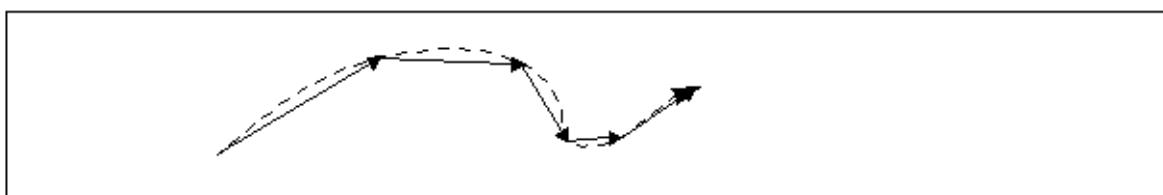


Figure 20 - An arbitrary motion trajectory is approximated as a piece-wise linear one.

If P_m is the position of the m^{th} vertex in the **IndexedFaceSet** in neutral state ($\text{FAP} = 0$), P'_m the position of the same vertex after animation with the given FAP and D_{mk} the 3D displacement in the k^{th} interval, the following algorithm shall be applied to determine the new position P'_m .

Determine, in which of the intervals listed in the table the received FAP is lying.

If the received FAP is lying in the j^{th} interval $[I_j, I_{j+1}]$ and $0 = I_k \leq I_j$, the new vertex position P'_m of the m^{th} vertex of the **IndexedFaceSet** is given by:

$$P'_m = \text{FAPU} * ((I_{k+1} - 0) * D_{m,k} + (I_{k+2} - I_{k+1}) * D_{m,k+1} + \dots + (I_j - I_{j-1}) * D_{m,j-1} + (\text{FAP} - I_j) * D_{m,j}) + P_m. \quad (\text{Eq. 1})$$

If $\text{FAP} > I_{\text{max}}$, then P'_m is calculated by using equation Eq. 1 and setting the index $j = \text{max}$.

If the received FAP is lying in the j^{th} interval $[I_j, I_{j+1}]$ and $I_{j+1} \leq I_k = 0$, the new vertex position P'_m is given by:

$$P'_m = \text{FAPU} * ((I_{j+1} - \text{FAP}) * D_{m,j} + (I_{j+2} - I_{j+1}) * D_{m,j+1} + \dots + (I_{k-1} - I_{k-2}) * D_{m,k-2} + (0 - I_{k-1}) * D_{m,k-1}) + P_m \quad (\text{Eq. 2})$$

If $\text{FAP} < I_1$, then P'_m is calculated by using equation Eq. 1 and setting the index $j+1 = 1$.

If for a given FAP and **IndexedFaceSet** the table contains only one interval, the motion is strictly linear:

$$P'_m = \text{FAPU} * \text{FAP} * D_{m,1} + P_m.$$

EXAMPLE —

```
FaceDefMesh {
    objectDescriptorID UpperLip
    intervalBorders [ -1000, 0, 500, 1000 ]
    coordIndex [ 50, 51 ]
    displacements [ 1 0 0, 0.9 0 0, 1.5 0 4, 0.8 0 0, 0.7 0 0, 2 0 0 ]
}
```

This **FaceDefMesh** defines the animation of the mesh “UpperLip”. For the piecewise-linear motion function three intervals are defined: [-1000, 0], [0, 500] and [500, 1000]. Displacements are given for the vertices with the indices 50 and 51. The displacements for the vertex 50 are: (1 0 0), (0.9 0 0) and (1.5 0 4), the displacements for vertex 51 are (0.8 0 0), (0.7 0 0) and (2 0 0). Given a FAPValue of 600, the resulting displacement for vertex 50 would be:

$$\text{displacement(vertex 50)} = 500 * (0.9 0 0)^T + 100 * (1.5 0 4)^T = (600 0 400)^T.$$

If the FAPValue is outside the given intervals, the boundary intervals are extended to +I or -I, as appropriate.

9.4.2.47 FaceDefTables

9.4.2.47.1 Node interface

FaceDefTables {

| | | | |
|--------------|---------|-------------------------|----|
| Field | SFInt32 | fapID | 0 |
| Field | SFInt32 | highLevelSelect | 0 |
| exposedField | MFNode | faceDefMesh | [] |
| exposedField | MFNode | faceDefTransform | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.38](#).

9.4.2.47.2 Functionality and semantics

The **FaceDefTables** node defines the behavior of a facial animation parameter FAP on a downloaded face model in **faceSceneGraph** by specifying the displacement vectors for moved vertices inside **IndexedFaceSet** objects as a function of the FAP **fapID** and/or specifying the value of a field of a **Transform** node as a function of FAP **fapID**.

The **FaceDefTables** node is transmitted directly after the BIFS bitstream of the **FDP** node. The **FaceDefTables** lists all FAPs that animate the face model. The FAPs animate the downloaded face model by updating the **Transform** or **IndexedFaceSet** nodes of the scene graph in **faceSceneGraph**. For each listed FAP, the **FaceDefTables** node describes which nodes are animated by this FAP and how they are animated. All FAPs that occur in the bitstream have to be specified in the **FaceDefTables** node. The animation generated by a FAP can be specified either by updating a **Transform** node (using a **FaceDefTransform**), or as a deformation of an **IndexedFaceSet** (using a **FaceDefMesh**).

The FAPUs shall be calculated by the terminal using the feature points that shall be specified in the FDP. The FAPUs are needed in order to animate the downloaded face model.

9.4.2.47.3 Semantics

The **fapID** field specifies the FAP, for which the animation behavior is defined in the **faceDefMesh** and **faceDefTransform** fields.

If **fapID** has value 1 or 2, the **highLevelSelect** field specifies the type of viseme or expression. In other cases this field has no meaning and shall be ignored.

The **faceDefMesh** field shall contain a **FaceDefMesh** node.

The **faceDefTransform** field shall contain a **FaceDefTransform** node.

9.4.2.48 FaceDefTransform

9.4.2.48.1 Node interface

FaceDefTransform {

| | | | |
|-------|------------|---------------------------|------------|
| Field | SFNode | faceSceneGraphNode | NULL |
| Field | SFInt32 | fieldId | 1 |
| Field | SFRotation | rotationDef | 0, 0, 1, 0 |
| Field | SFVec3f | scaleDef | 1, 1, 1 |
| Field | SFVec3f | translationDef | 0, 0, 0 |

}

NOTE — For the binary encoding of this node see Annex [H.1.39](#).

9.4.2.48.2 Functionality and semantics

The **FaceDefTransform** node defines which field (**rotation**, **scale** or **translation**) of a **Transform** node (**faceSceneGraphNode**) of **faceSceneGraph** (defined in an **FDP** node) is updated by a facial animation

parameter, and how the field is updated. If the face is in its neutral position, the **faceSceneGraphNode** has its **translation**, **scale**, and **rotation** fields set to the neutral values $(0,0,0)^T$, $(1,1,1)^T$, $(0,0,1,0)$, respectively.

The **faceSceneGraphNode** field specifies the **Transform** node for which the animation is defined. The node shall be part of **faceScenegraph** as defined in the **FDP** node.

The **fieldId** field specifies which field in the **Transform** node, specified by the **faceSceneGraphNode** field, is updated by the FAP during animation. Possible fields are **translation**, **rotation**, **scale**.

- If **fieldID==1**, **rotation** shall be updated using **rotationDef** and **FAPValue**.
- If **fieldID==2**, **scale** shall be updated using **scaleDef** and **FAPValue**.
- If **fieldID==3**, **translation** shall be updated using **translationDef** and **FAPValue**.

The **rotationDef** field is of type **SFRotation**. With **rotationDef** $=(r_x, r_y, r_z, \theta)$, the new value of the **rotation** field of the **Transform** node **faceSceneGraphNode** is:

$$\text{rotation} := (r_x, r_y, r_z, \theta * \text{FAPValue} * \text{AU}) \quad [\text{AU is defined in ISO/IEC FCD 14496-2}]$$

The **scaleDef** field is of type **SFVec3f**. The new value of the **scale** field of the **Transform** node **faceSceneGraphNode** is:

$$\text{scale} := \text{FAPValue} * \text{scaleDef}$$

The **translationDef** field is of type **SFVec3f**. The new value of the **translation** field of the **Transform** node **faceSceneGraphNode** is:

$$\text{translation} := \text{FAPValue} * \text{translationDef}$$

9.4.2.49 FAP

9.4.2.49.1 Node interface

FAP {

| | | | |
|--------------|---------|--------------------------|------|
| exposedField | SFNode | viseme | NULL |
| exposedField | SFNode | expression | NULL |
| exposedField | SFInt32 | open_jaw | +I |
| exposedField | SFInt32 | lower_t_midlip | +I |
| exposedField | SFInt32 | raise_b_midlip | +I |
| exposedField | SFInt32 | stretch_l_corner | +I |
| exposedField | SFInt32 | stretch_r_corner | +I |
| exposedField | SFInt32 | lower_t_lip_lm | +I |
| exposedField | SFInt32 | lower_t_lip_rm | +I |
| exposedField | SFInt32 | lower_b_lip_lm | +I |
| exposedField | SFInt32 | lower_b_lip_rm | +I |
| exposedField | SFInt32 | raise_l_cornerlip | +I |
| exposedField | SFInt32 | raise_r_cornerlip | +I |
| exposedField | SFInt32 | thrust_jaw | +I |
| exposedField | SFInt32 | shift_jaw | +I |
| exposedField | SFInt32 | push_b_lip | +I |
| exposedField | SFInt32 | push_t_lip | +I |
| exposedField | SFInt32 | depress_chin | +I |
| exposedField | SFInt32 | close_t_l_eyelid | +I |
| exposedField | SFInt32 | close_t_r_eyelid | +I |
| exposedField | SFInt32 | close_b_l_eyelid | +I |
| exposedField | SFInt32 | close_b_r_eyelid | +I |
| exposedField | SFInt32 | yaw_l_eyeball | +I |
| exposedField | SFInt32 | yaw_r_eyeball | +I |
| exposedField | SFInt32 | pitch_l_eyeball | +I |
| exposedField | SFInt32 | pitch_r_eyeball | +I |

| | | | |
|--------------|---------|------------------------------|----|
| exposedField | SFInt32 | thrust_l_eyeball | +I |
| exposedField | SFInt32 | thrust_r_eyeball | +I |
| exposedField | SFInt32 | dilate_l_pupil | +I |
| exposedField | SFInt32 | dilate_r_pupil | +I |
| exposedField | SFInt32 | raise_l_i_eyebrow | +I |
| exposedField | SFInt32 | raise_r_i_eyebrow | +I |
| exposedField | SFInt32 | raise_l_m_eyebrow | +I |
| exposedField | SFInt32 | raise_r_m_eyebrow | +I |
| exposedField | SFInt32 | raise_l_o_eyebrow | +I |
| exposedField | SFInt32 | raise_r_o_eyebrow | +I |
| exposedField | SFInt32 | squeeze_l_eyebrow | +I |
| exposedField | SFInt32 | squeeze_r_eyebrow | +I |
| exposedField | SFInt32 | puff_l_cheek | +I |
| exposedField | SFInt32 | puff_r_cheek | +I |
| exposedField | SFInt32 | lift_l_cheek | +I |
| exposedField | SFInt32 | lift_r_cheek | +I |
| exposedField | SFInt32 | shift_tongue_tip | +I |
| exposedField | SFInt32 | raise_tongue_tip | +I |
| exposedField | SFInt32 | thrust_tongue_tip | +I |
| exposedField | SFInt32 | raise_tongue | +I |
| exposedField | SFInt32 | tongue_roll | +I |
| exposedField | SFInt32 | head_pitch | +I |
| exposedField | SFInt32 | head_yaw | +I |
| exposedField | SFInt32 | head_roll | +I |
| exposedField | SFInt32 | lower_t_midlip_o | +I |
| exposedField | SFInt32 | raise_b_midlip_o | +I |
| exposedField | SFInt32 | stretch_l_cornerlip | +I |
| exposedField | SFInt32 | stretch_r_cornerlip_o | +I |
| exposedField | SFInt32 | lower_t_lip_lm_o | +I |
| exposedField | SFInt32 | lower_t_lip_rm_o | +I |
| exposedField | SFInt32 | raise_b_lip_lm_o | +I |
| exposedField | SFInt32 | raise_b_lip_rm_o | +I |
| exposedField | SFInt32 | raise_l_cornerlip_o | +I |
| exposedField | SFInt32 | raise_r_cornerlip_o | +I |
| exposedField | SFInt32 | stretch_l_nose | +I |
| exposedField | SFInt32 | stretch_r_nose | +I |
| exposedField | SFInt32 | raise_nose | +I |
| exposedField | SFInt32 | bend_nose | +I |
| exposedField | SFInt32 | raise_l_ear | +I |
| exposedField | SFInt32 | raise_r_ear | +I |
| exposedField | SFInt32 | pull_l_ear | +I |
| exposedField | SFInt32 | pull_r_ear | +I |

}

NOTE — For the binary encoding of this node see Annex [H.1.40](#).

9.4.2.49.2 Functionality and semantics

This node defines the current look of the face by means of expressions and FAPs and gives a hint to TTS controlled systems on which viseme to use. For a definition of the facial animation parameters see ISO/IEC 14496-2, Annex C.

The **viseme** field shall contain a **Viseme** node.

The **expression** field shall contain an **Expression** node.

The semantics for the remaining fields are described in the ISO/IEC 14496-2, Annex C and in particular in Table C-1.

A FAP of value +I shall be interpreted as indicating that the particular FAP is uninitialized.

9.4.2.50 FDP

9.4.2.50.1 Node interface

```
FDP {
    exposedField SFNode      featurePointsCoord   NULL
    exposedField SFNode      textureCoords        NULL
    exposedField SFBool       useOrthoTexture     FALSE
    exposedField MFNode      faceDefTables      []
    exposedField MFNode      faceSceneGraph     []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.41](#).

9.4.2.50.2 Functionality and semantics

The **FDP** node defines the face model to be used at the terminal. Two options are supported:

1. If **faceDefTables** is NULL, calibration information is downloaded, so that the proprietary face of the terminal can be calibrated using facial feature points and, optionally, the texture information. In this case, the **featurePointsCoord** field shall be set. **featurePointsCoord** contains the coordinates of facial feature points, as defined in ISO/IEC 14496-2, Annex C, Figure C-1, corresponding to a neutral face. If a coordinate of a feature point is set to +1, the coordinates of this feature point shall be ignored. The **textureCoord** field, if set, is used to map a texture on the model calibrated by the feature points. The **textureCoord** points correspond to the feature points. That is, each defined feature point shall have corresponding texture coordinates. In this case, the **faceSceneGraph** shall contain exactly one texture image, and any geometry it might contain shall be ignored. The terminal shall interpret the feature points, texture coordinates, and the **faceSceneGraph** in the following way:
 - Feature points of the terminal's face model shall be moved to the coordinates of the feature points supplied in **featurePointsCoord**, unless a feature point is to be ignored, as explained above.
 - If **textureCoord** is set, the texture supplied in the **faceSceneGraph** shall be mapped onto the terminal's default face model. The texture coordinates are derived from the texture coordinates of the feature points supplied in **textureCoords**. The **useOrthoTexture** field provides a hint to the decoding terminal that, when FALSE, indicates that the texture image is best obtained by cylindrical projection of the face. If **useOrthoTexture** is TRUE, the texture image is best obtained by orthographic projection of the face.
2. A face model as described in the **faceSceneGraph** is decoded. This face model replaces the terminal's default face model in the terminal. The **faceSceneGraph** shall contain the face in its neutral position (all FAPs = 0). If desired, the **faceSceneGraph** shall contain the texture maps of the face. The functions defining the way in which the **faceSceneGraph** shall be modified, as a function of the FAPs, shall also be decoded. This information is described by **faceDefTables** that define how the **faceSceneGraph** is to be modified as a function of each FAP. By means of **faceDefTables**, **IndexedFaceSets** and **Transform** nodes of the **faceSceneGraph** can be animated. Since the amplitude of FAPs is defined in units that are dependent on the size of the face model, the **featurePointsCoord** field defines the position of facial features on the surface of the face described by **faceSceneGraph**. From the location of these feature points, the terminal computes the units of the FAPs. Generally, only two node types in the scene graph of a decoded face model are affected by FAPs: **IndexedFaceSet** and **Transform** nodes. If a FAP causes a deformation of an object (e.g. lip stretching), then the coordinate positions in the affected **IndexedFaceSets** shall be updated. If a FAP causes a movement which can be described with a **Transform** node (e.g. FAP 23, yaw_l_eyeball), then the appropriate fields in this **Transform** node shall be updated. It shall be assumed that this **Transform** node has its **rotation**, **scale**, and **translation** fields set to neutral values if the face is in its neutral position. A unique **nodeId** shall be assigned via the DEF statement to all **IndexedFaceSet** and **Transform** nodes which are affected by FAPs so that they can be accessed unambiguously during animation.

The **featurePointsCoord** field shall contain a **Coordinate** node that specifies feature points for the calibration of the terminal's default face. The coordinates are specified in the **point** field of the **Coordinate** node in the prescribed order, that a feature point with a lower label number is listed before a feature point with a higher label number.

EXAMPLE — Feature point 3.14 before feature point 4.1

The **textureCoords** field shall contain a **Coordinate** node that specifies texture coordinates for the feature points. The coordinates are listed in the **point** field in the **Coordinate** node in the prescribed order, that a feature point with a lower label is listed before a feature point with a higher label.

The **useOrthoTexture** field may contain a hint to the terminal as to the type of texture image, in order to allow better interpolation of texture coordinates for the vertices that are not feature points. If **useOrthoTexture** is FALSE, the terminal may assume that the texture image was obtained by cylindrical projection of the face. If **useOrthoTexture** is 1, the terminal may assume that the texture image was obtained by orthographic projection of the face.

The **faceDefTables** field shall contain **FaceDefTables** nodes. The behavior of FAPs is defined in this field for the face in **faceSceneGraph**.

The **faceSceneGraph** field shall contain a **Group** node. In the case of option 1 (above), this may be used to contain a texture image as described above. In the case of option 2, this shall be the grouping node for the face model rendered in the compositor and shall contain the face model. In this case, the effect of facial animation parameters is defined in the **faceDefTables** field.

9.4.2.51 FIT

9.4.2.51.1 Node interface

| | | | |
|----------------------|-------------------------|--|---|
| FIT { | | | |
| exposedField MFInt32 | FAPs | | □ |
| exposedField MFInt32 | graph | | □ |
| exposedField MFInt32 | numeratorTerms | | □ |
| exposedField MFInt32 | denominatorTerms | | □ |
| exposedField MFInt32 | numeratorExp | | □ |
| exposedField MFInt32 | denominatorExp | | □ |
| exposedField MFInt32 | numeratorImpulse | | □ |
| exposedField MFFloat | numeratorCoefs | | □ |
| exposedField MFFloat | denominatorCoefs | | □ |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.42](#).

9.4.2.51.2 Functionality and semantics

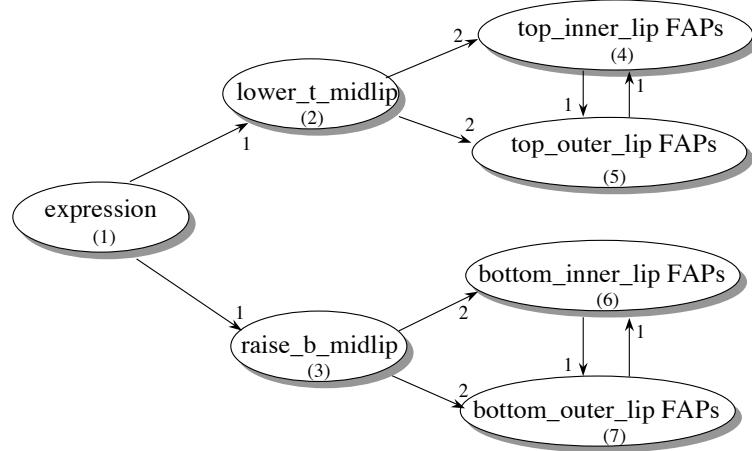
The **FIT** node allows a smaller set of FAPs to be sent during a facial animation. This small set can then be used to determine the values of other FAPs, using a rational polynomial mapping between parameters. In a **FIT** node, rational polynomials are used to specify interpolation functions.

EXAMPLE — The top inner lip FAPs can be sent and then used to determine the top outer lip FAPs. Another example is that only viseme and/or expression FAPs are sent to drive the face. In this case, low-level FAPs are interpolated from these two high-level FAPs.

To make the scheme general, sets of FAPs are specified, along with a FAP interpolation graph (FIG) between the sets that specifies which sets are used to determine which other sets. The FIG is a graph with directed links. Each node contains a set of FAPs. Each link from a parent node to a child node indicates that the FAPs in the child node can be interpolated from the parent node. **Expression** (FAP#1) or **Viseme** (FAP #2) and their fields shall not be interpolated from other FAPs.

In a FIG, a FAP may appear in several nodes, and a node may have multiple parents. For a node that has multiple parent nodes, the parent nodes are ordered as 1st parent node, 2nd parent node, etc. During the interpolation process, if this child node needs to be interpolated, it is first interpolated from 1st parent node if all FAPs in that parent node are available. Otherwise, it is interpolated from 2nd parent node, and so on.

An example of FIG is shown in Figure 21. Each node has a **nodeID**. The numerical label on each incoming link indicates the order of these links.

**Figure 21 - A FIG example**

The interpolation process based on the FAP interpolation graph is described using pseudo-C code as follows:

```

do {
    interpolation_count = 0;
    for (all Node_i) { // from Node_1 to Node_N
        for (ordered Node_i's parent Node_k) {
            if (FAPs in Node_i need interpolation and
                FAPs in Node_k have been interpolated or are available) {
                interpolate Node_i from Node_k; //using interpolation function
                // table here
                interpolation_count++;
                break;
            }
        }
    }
} while (interpolation_count != 0);

```

Each directed link in a FIG is a set of interpolation functions. Suppose F_1, F_2, \dots, F_n are the FAPs in a parent set and f_1, f_2, \dots, f_m are the FAPs in a child set.

Then, there are m interpolation functions denoted as:

$$f_1 = I_1(F_1, F_2, \dots, F_n)$$

$$f_2 = I_2(F_1, F_2, \dots, F_n)$$

...

$$f_m = I_m(F_1, F_2, \dots, F_n)$$

Each interpolation function $I_k()$ is in a rational polynomial form if the parent node does not contain viseme FAP or expression FAP.

$$I(F_1, F_2, \dots, F_n) = \sum_{i=0}^{K-1} (c_i \prod_{j=1}^n F_j^{l_{ij}}) / \sum_{i=0}^{P-1} (b_i \prod_{j=1}^n F_j^{m_{ij}})$$

Otherwise, an impulse function is added to each numerator polynomial term to allow selection of expression or viseme.

$$I(F_1, F_2, \dots, F_n) = \sum_{i=0}^{K-1} \delta(F_{s_i} - a_i) \left(c_i \prod_{j=1}^n F_j^{l_{ij}} \right) / \sum_{i=0}^{P-1} \left(b_i \prod_{j=1}^n F_j^{m_{ij}} \right)$$

In both equations, K and P are the numbers of polynomial products, c_i and b_i are the coefficient of the i th product. l_{ij} and m_{ij} are the power of F_j in the i th product. An impulse function equals 1 when $F_{s_i} = a_i$, otherwise, equals 0. F_{s_i} can only be viseme_select1, viseme_select2, expression_select1, and expression_select2. a_i is an integer that ranges from 0 to 6 when F_{s_i} is expression_select1 or expression_select2, ranges 0 to 14 when F_{s_i} is viseme_select1 or viseme_select2. The encoder shall send an interpolation function table which contains $K, P, a_i, s_i, c_i, b_i, l_{ij}, m_{ij}$ to the terminal.

To aid in the explanation below, it is assumed that there are N different sets of FAPs with index 1 to N , and that each set has n_i , $i=1,\dots,N$ parameters. It is also assumed that there are L directed links in the FIG and that each link points from the FAP set with index P_i to the FAP set with index C_i , for $i = 1, \dots, L$

The FAPs field shall contain a list of FAP-indices specifying which animation parameters form sets of FAPs. Each set of FAP indices is terminated by -1. There shall be a total of $N + n_1 + n_2 + \dots + n_N$ numbers in this field, with N of them being -1. FAP#1 to FAP#68 are of indices 1 to 68. Fields of the **Viseme** FAP (FAP#1), namely, **viseme_select1**, **viseme_select2**, **viseme_blend**, are of indices from 69 to 71. Fields of the **Expression** FAP (FAP#2), namely, **expression_select1**, **expression_select2**, **expression_intensity1**, **expression_intensity2** are of indices from 72 to 75. When the parent node contains a **Viseme** FAP, three indices, 69, 70, 71, shall be included in the node (but not index 1). When a parent node contains an **Expression** FAP, four indices, 72, 73, 74, 75, shall be included in the node (but not index 2).

The **graph** field shall contain a list of pairs of integers, specifying a directed links between sets of FAPs. The integers refer to the indices of the sets specified in the **FAPs** field, and thus range from 1 to N . When more than one direct link terminates at the same set, that is, when the second value in the pair is repeated, the links have precedence determined by their order in this field. This field shall have a total of $2L$ numbers, corresponding to the directed links between the parents and children in the FIG.

The **numeratorTerms** field shall be a list containing the number of terms in the polynomials of the numerators of the rational functions used to interpolae parameter values. Each element in the list corresponds to K in equation 1 above). Each link i (that is, the i th integer pair) in the **graph** field must have n_{Ci} values specified, one for each child FAP. The order in the **numeratorTerms** list shall correspond to the order of the links in the **graph** field and the order that the child FAP appears in the **FAPs** field. There shall be $n_{C1} + n_{C2} + \dots + n_{CL}$ numbers in this field.

The **denominatorTerms** field shall contain a list of the number of terms in the polynomials of the denominator of the rational functions controlling the parameter value. Each element in the list corresponds to P in equation 1. Each link i (that is, the i th integer pair) in the **graph** field must have n_{Ci} values specified, one for each child FAP. The order in the **denominatorTerms** list corresponds to the order of the links in the **graph** field and the order that the child FAP appears in the **FAPs** field. There shall be $n_{C1} + n_{C2} + \dots + n_{CL}$ numbers in this field.

The **numeratorImpulse** field shall contain a list of impulse functions in the numerator of the rational function for links with the **Viseme** or **Expression** FAP in parent node. This list corresponds to the $\delta(F_{s_i} - a_i)$. Each entry in the list is (s_i, a_i) .

The **numeratorExp** field shall contain a list of exponents of the polynomial terms in the numerator of the rational function controlling the parameter value. This list corresponds to l_{ij} . For each child FAP in each link i , $n_{Pi} * K$ values need to be specified. The order in the **numeratorExp** list shall correspond to the order of the links in the **graph** field and the order that the child FAP appears in the **FAPs** field.

NOTE — K may be different for each child FAP.

The **denominatorExp** field shall contain a list of exponents of the polynomial terms of the denominator of the rational function controlling the parameter value. This list corresponds to m_{ij} . For each child FAP in each link i ,

n_{Pi}^*P values need to be specified. The order in the **denominatorExp** list shall correspond to the order of the links in the **graph** field and the order that the child FAP appears in the **FAPs** field.

NOTE — P may be different for each child FAP.

The **numeratorCoefs** field shall contain a list of coefficients of the polynomial terms of the numerator of the rational function controlling the parameter value. This list corresponds to c_i . The list shall have K terms for each child parameter that appears in a link in the FIG, with the order in **numeratorCoefs** corresponding to the order in **graph** and **FAPs**.

NOTE — K is dependent on the polynomial, and is not a fixed constant.

The **denominatorCoefs** field shall contain a list of coefficients of the polynomial terms in the numerator of the rational function controlling the parameter value. This list corresponds to b_i . The list shall have P terms for each child parameter that appears in a link in the FIG, with the order in **denominatorCoefs** corresponding to the order in **graph** and **FAPs**.

NOTE — P is dependent on the polynomial, and is not a fixed constant.

EXAMPLE — Suppose a FIG contains four nodes and 2 links. Node 1 contains FAP#3, FAP#3, FAP#5. Node 2 contains FAP#6, FAP#7. Node 3 contains an expression FAP, which means contains FAP#72, FAP#73, FAP#74, and FAP#75. Node 4 contains FAP#12 and FAP#17. Two links are from node 1 to node 2, and from node 3 to node 4. For the first link, the interpolation functions are

$$F_6 = (F_3 + 2F_4 + 3F_5 + 4F_3F_4^2)/(5F_5 + 6F_3F_4F_5)$$

$$F_7 = F_4$$

For the second link, the interpolation functions are

$$F_{12} = \delta(F_{72} - 6)(0.6F_{74}) + \delta(F_{73} - 6)(0.6F_{75})$$

$$F_{17} = \delta(F_{72} - 6)(-1.5F_{74}) + \delta(F_{73} - 6)(-1.5F_{75})$$

The second link simply says that when the expression is surprise (FAP#72=6 or FAP#73=6), for FAP#12, the value is 0.6 times of expression intensity FAP#74 or FAP#75; for FAP#17, the value is -1.5 times of FAP#74 or FAP#75.

After the FIT node given below, we explain each field separately.

```

FIT {
  FAPs      [ 3 4 5 -1 6 7 -1 72 73 74 75 -1 12 17 -1]
  graph     [ 1 2 3 4]
  numeratorTerms [ 4 1 2 2 ]
  denominatorTerms [ 2 1 1 1 ]
  numeratorExp   [ 1 0 0 0 1 0 0 0 1 1 2 0 0 1 0
                  0 0 1 0 0 0 0 1 0 0 1 0 0 0 1 ]
  denominatorExp [ 0 0 1 1 1 1 0 0 0
                  0 0 0 0 0 0 0 0 ]
  numeratorImpulse [ 72 6 73 6 72 6 73 6 ]
  numeratorCoefs  [ 1 2 3 4 1 0.6 0.6 -1.5 -1.5 ]
  denominatorCoefs [ 5 6 1 1 1 ]
}

```

FAPs [3 4 5 -1 6 7 -1 72 73 74 75 -1 12 17 -1]

Four sets of FAPs are defined, the first with FAPs number 3, 4, and 5, the second with FAPs number 6 and 7, the third with FAPs number 72, 73, 74, 75, and the fourth with FAPs number 12, 17.

graph [1 2 3 4]

The first set is made to be the parent of the second set, so that FAPs number 6 and 7 will be determined by FAPs 3, 4, and 5. Also, the third set is made to be the parent of the fourth set, so that FAPs number 12 and 17 will be determined by FAPs 72, 73, 74, and 75.

numeratorTerms [4 1 2 2]

The rational functions that define F6 and F7 are selected to have 4 and 1 terms in their numerator, respectively. Also, the rational functions that define F12 and F17 are selected to have 2 and 2 terms in their numerator, respectively.

```
denominatorTerms [ 2 1 1 1 ]
```

The rational functions that define F6 and F7 are selected to have 2 and 1 terms in their denominator, respectively. Also, the rational functions that define F12 and F17 are selected to both have 1 term in their denominator.

```
numeratorExp [ 1 0 0 0 1 0 0 0 1 1 2 0 0 1 0 0 0 1 0 0 0 0 1 0 0 1 0 0 0 0 1 ]
```

The numerator selected for the rational function defining F6 is $F_3 + 2F_4 + 3F_5 + 4F_3F_4F_2$. There are 3 parent FAPs, and 4 terms, leading to 12 exponents for this rational function. For F7, the numerator is just F_4 , so there are three exponents only (one for each FAP). Values for F12 and F17 are derived in the same way.

```
denominatorExp [ 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 ]
```

The denominator selected for the rational function defining F6 is $5F_5 + 6F_3F_4F_5$, so there are 3 parent FAPs and 2 terms and hence, 6 exponents for this rational function. For F7, the denominator is just 1, so there are three exponents only (one for each FAP). Values for F12 and F17 are derived in the same way.

```
numeratorImpulse [ 72 6 73 6 72 6 73 6 ]
```

For the second link, all four numerator polynomial terms contain impulse function $\delta(F_{72} - 6)$ or $\delta(F_{73} - 6)$.

```
numeratorCoefs [ 1 2 3 4 1 0.6 0.6 -1.5 -1.5 ]
```

There is one coefficient for each term in the numerator of each rational function.

```
denominatorCoefs [ 5 6 1 1 1 ]
```

There is one coefficient for each term in the denominator of each rational function.

9.4.2.52 Fog

9.4.2.52.1 Node interface

```
Fog {
    exposedField SFColor      color           1 1 1
    exposedField SFString     fogType         "LINEAR"
    exposedField SFFloat       visibilityRange 0.0
    eventIn      SFBool        set_bind
    eventOut     SFBool        isBound
}
```

NOTE — For the binary encoding of this node see Annex [H.1.43](#).

9.4.2.52.2 Functionality and semantics

The semantics of the **Fog** node are specified in ISO/IEC 14772-1:1998, subclause 6.19.

9.4.2.53 FontStyle

9.4.2.53.1 Node interface

```
FontStyle {
    field      MFString      family          ["SERIF"]
    field      SFBool        horizontal      TRUE
    field      MFString      justify         ["BEGIN"]
    field      SFString     language        ""
    field      SFBool        leftToRight    TRUE
    field      SFFloat       size            1.0
    field      SFFloat       spacing         1.0
    field      SFString     style           "PLAIN"
    field      SFBool        topToBottom   TRUE
}
```

NOTE — For the binary encoding of this node see Annex [H.1.44](#).

9.4.2.53.2 Functionality and semantics

The semantics of the **FontStyle** node are specified in ISO/IEC 14772-1:1998, subclause 6.20. The distance between adjacent text baselines is the sum of the size and the spacing. (Note, that this makes that the text size is the sum of the ascent + descent + leading, the latter which is the interline spacing, the logical amount of space to be reserved between the descent of one line of text and the ascent of the next line).

9.4.2.54 Form

9.4.2.54.1 Node interface

Form {

| | | | |
|--------------|----------|-----------------------|--------|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFVec2f | size | -1, -1 |
| exposedField | MFIInt32 | groups | [] |
| exposedField | MFIInt32 | constraints | [] |
| exposedField | MFIInt32 | groupsIndex | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.45](#).

9.4.2.54.2 Functionality and semantics

The **Form** node specifies the placement of its children according to relative alignment and distribution constraints. Distribution spreads objects regularly, with an equal spacing between them.

The **children** field shall specify a list of nodes that are to be arranged. The children's position is implicit and order is important.

The **size** field specifies the width and height of the layout frame.

The **groups** field specifies the list of groups of objects on which the constraints can be applied. The children of the **Form** node are numbered from 1 to n, 0 being reserved for a reference to the form itself. A group is a list of child indices, terminated by a -1.

The **constraints** and the **groupsIndex** fields specify the list of constraints. One constraint is constituted by a constraint type from the **constraints** field, coupled with a set of group indices terminated by a -1 contained in the **groupsIndex** field. There shall be as many strings in **constraints** as there are -1-terminated sets in **groupsIndex**. The n-th constraint string shall be applied to the n-th set in the **groupsIndex** field.

Constraints belong to two categories: alignment and distribution constraints.

Components referred to in the tables below are components whose indices appear in the list following the constraint type. When rank is mentioned, it refers to the rank in that list.

The semantics of the **<S>**, when present in the name of a constraint, is the following. It shall be a number, integer when the scene uses pixel metrics, and float otherwise, which specifies the space mentioned in the semantics of the constraint.

Table 35 - Alignment Constraints

| Alignment Constraints | Type Index | Effect |
|--------------------------------|------------|--|
| AL: Align Left edges | "AL" | The xmin of constrained components becomes equal to the xmin of the left-most component. |
| AH: Align centers Horizontally | "AH" | The (xmin+xmax)/2 of constrained components becomes equal to the (xmin+xmax)/2 of the group of constrained components as computed before this constraint is applied. |
| AR: Align Right edges | "AR" | The xmax of constrained components becomes equal to the xmax of the right-most component. |

| Alignment Constraints | Type Index | Effect |
|--|------------|--|
| AT: Align Top edges | "AT" | The ymax of all constrained components becomes equal to the ymax of the top-most component. |
| AV: Align centers Vertically | "AV" | The (ymin+ymax)/2 of constrained components becomes equal to the (ymin+ymax)/2 of the group of constrained components as computed before this constraint is applied. |
| AB: Align Bottom edges | "AB" | The ymin of constrained components becomes equal to the ymin of the bottom-most component. |
| ALspace: Align Left edges by specified space | "AL <s>" | The xmin of the second and following components become equal to the xmin of the first component plus the specified space. |
| ARspace: Align Right edges by specified space | "AR <s>" | The xmax of the second and following components becomes equal to the xmax of the first component minus the specified space. |
| ATspace: Align Top edges by specified space | "AT <s>" | The ymax of the second and following components becomes equal to the ymax of the first component minus the specified space. |
| ABspace: Align Bottom edges by specified space | "AB <s>" | The ymin of the second and following components become equal to the ymin of the first component plus the specified space. |

The purpose of distribution constraints is to specify the space between components, by making such pairwise gaps equal either to a given value or to the effect of filling available space.

Table 36 - Distribution Constraints

| Distribution Constraints | Type Index | Effect |
|---|------------|---|
| SH: Spread Horizontally | "SH" | The differences between the xmin of each component and the xmax of the previous one all become equal. The first and the last component shall be constrained horizontally already. |
| SHin: Spread Horizontally in container | "SHin" | The differences between the xmin of each component and the xmax of the previous one all become equal. References are the edges of the layout. |
| SHspace: Spread Horizontally by specified space | "SH <s>" | The difference between the xmin of each component and the xmax of the previous one all become equal to the specified space. The first component is not moved. |
| SV: Spread Vertically | "SV" | The differences between the ymin of each component and the ymax of the previous one all become equal. The first and the last component shall be constrained vertically already. |
| SVin: Spread Vertically in container | "SVin" | The differences between the ymin of each component and the ymax of the previous one all become equal. References are the edges of the layout. |
| SVspace: Spread Vertically by specified space | "SV <s>" | The difference between the ymin of each component and the ymax of the previous one all become equal to the specified space. The first component is not moved. |

All objects start at the center of the **Form**. The constraints are then applied in sequence.

EXAMPLE — Laying out five 2D objects.

```
shape {
    Geometry2D Rectangle { size 50 55 } // draw the Form's frame.
    VisualProps use VPSRect
}

Transform2D {
    translation 10 10 {
        children [
            Form {
                children [
                    Shape2D { use OBJ1 }
                    Shape2D { use OBJ2 }
                    Shape2D { use OBJ3 }
                ]
            }
        ]
    }
}
```

```

        Shape2D { use OBJ4 }
        Shape2D { use OBJ5 }
    ]
    size 50 55
groups [ 1 -1 2 -1 3 -1 4 -1 5 -1 1 3 -1]
constraints ["SH" "SV" "AR" "AB" "AB 6"
            "AB 7" "AL 7" "AT -2" "AR -2"]
groupsIndex [6 -1 1 -1 0 2 -1 0 2 -1 0 3 -1
            0 4 -1 0 4 -1 0 5 -1 0 5 -1]
}
]
}
}

```

The above **constraints** specify the following operations:

- spread group 6 (objects 1 and 3) horizontally in container (object 0)
- spread group 1 (object 1) vertically in container
- align the right edges of groups 0 (container) and 2 (object 2)
- align the bottom edges of the container and group 2 (object 2)
- align the bottom edges of the container and group 3 (object 3) with spacing of size 6
- align the bottom edges of the container and group 4 (object 4) with spacing of size 7
- align the left edges of the container and group 4 (object 4) with spacing of size 7
- align the top edges of the container and group 5 (object 5) with spacing size of -2
- align the right edges of the container and group 5 (object 5) with spacing size of -2

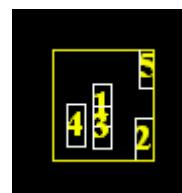


Figure 22 - Visual result of the Form node example

9.4.2.55 Group

9.4.2.55.1 Node interface

```

Group {
    eventIn      MFNode      addChildren
    eventIn      MFNode      removeChildren
    exposedField MFNode      children          []
}

```

NOTE — For the binary encoding of this node see Annex [H.1.46](#).

9.4.2.55.2 Functionality and semantics

The semantics of the **Group** node are specified in ISO/IEC 14772-1:1998, subclause 6.21. ISO/IEC 14496-1 does not support the bounding box parameters (**bboxCenter** and **bboxSize**).

Where multiple sub-graphs containing audio content (i.e. **Sound** nodes) occur as children of a **Group** node, the sounds shall be combined as described in 9.4.2.94.

9.4.2.56 Hierarchical3Dmesh

9.4.2.56.1 Node Interface

```
Hierarchical3DMesh {
    eventIn          SFInt32   TriangleBudget
    exposedField     SFFloat   level
    field            MFString  url
    eventOut         SFBool    doneLoading
}
[]
```

NOTE - For the binary encoding of this node see Annex [H.3.10](#).

9.4.2.56.2 Functionality and Semantics

The **Hierarchical3DMesh** is used to represent multi-resolution polygonal models with multiple levels of detail (LOD), smooth transition (interpolation) between consecutive levels, and hierarchical transmission through an independent elementary stream encoded with the 3D Mesh Coding tools (see ISO/IEC 14496-2:1999). The implementation of the **Hierarchical3DMesh** requires two execution threads, the *decoder* thread, and the *player* thread.

The decoder thread decodes the compressed 3D Mesh bitstream from the elementary stream specified in the **url** field, and reconstructs the LOD hierarchy and the information necessary to implement the smooth transition property in internal data structures. How the LOD hierarchy is stored in the internal data structures, and whether all or a subset of the transmitted hierarchy is stored for player interaction is implementation-dependent.

The decoder thread is started immediately after instantiation. Once this thread finishes decoding the compressed 3D Mesh bitstream, it sends a **done_loading** eventOut with the value TRUE to the player, and dies.

The **Hierarchical3DMesh** is seen by the player as a read-only **IndexedFaceSet** node. That is, the player has access to the following fields for rendering purposes, but they can neither be explicitly instantiated, nor modified by routing events into them:

| | | |
|-------|---------|-----------------|
| field | SFNode | color |
| field | SFNode | coord |
| field | SFNode | normal |
| field | SFNode | texCoord |
| field | SFBool | ccw |
| field | MFInt32 | colorIndex |
| field | SFBool | colorPerVertex |
| field | SFBool | convex |
| field | MFInt32 | coordIndex |
| field | SFFloat | creaseAngle |
| field | MFInt32 | normalIndex |
| field | SFBool | normalPerVertex |
| field | SFBool | solid |
| field | MFInt32 | texCoordIndex |

The player thread is responsible for switching levels of detail responding to the **set_level** and **triangleBudget** eventIn events sent by the player. It does so by modifying the fields of the **IndexedFaceSet** seen by the player from information stored in the internal data structures build by the decoder thread.

The **level** exposedField (between 0 and 1) is used to (1) set a particular fractional level, (2) query the current level, (3) as an eventOut to notify the browser when a level was actually set and which level it is.

Optionally, the player can set the level of detail by sending a **triangleBudget** eventIn to the node. The value of the **triangleBudget** eventIn represents the desired number of triangles that the player assigns to the node. The node must select a level of detail that best matches the given budget.

9.4.2.57 ImageTexture

9.4.2.57.1 Node interface

| | | | |
|-----------------------|----------|----------------|------|
| ImageTexture { | | | |
| exposedField field | MFString | url | [] |
| field | SFBool | repeatS | TRUE |
| field | SFBool | repeatT | TRUE |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.47](#).

9.4.2.57.2 Functionality and semantics

The semantics of the **ImageTexture** node are specified in ISO/IEC 14772-1:1998, subclause 6.22.

The **url** field specifies the data source to be used (see 9.2.2.7.1).

9.4.2.58 IndexedFaceSet

9.4.2.58.1 Node interface

| | | | |
|-------------------------|---------|--------------------------|------|
| IndexedFaceSet { | | | |
| eventIn | MFInt32 | set_colorIndex | |
| eventIn | MFInt32 | set_coordIndex | |
| eventIn | MFInt32 | set_normalIndex | |
| eventIn | MFInt32 | set_texCoordIndex | |
| exposedField | SFNode | color | NULL |
| exposedField | SFNode | coord | NULL |
| exposedField | SFNode | normal | NULL |
| exposedField | SFNode | texCoord | NULL |
| field | SFBool | ccw | TRUE |
| field | MFInt32 | colorIndex | [] |
| field | SFBool | colorPerVertex | TRUE |
| field | SFBool | convex | TRUE |
| field | MFInt32 | coordIndex | [] |
| field | SFFloat | creaseAngle | 0.0 |
| field | MFInt32 | normalIndex | [] |
| field | SFBool | normalPerVertex | TRUE |
| field | SFBool | solid | TRUE |
| field | MFInt32 | texCoordIndex | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.48](#).

9.4.2.58.2 Functionality and semantics

The semantics of the **IndexedFaceSet** node are specified in ISO/IEC 14772-1:1998, subclause 6.23. Some restrictions on these semantics are described below.

The **IndexedFaceSet** node represents a 3D polygon mesh formed by constructing faces (polygons) from points specified in the **coord** field. If the **coordIndex** field is not NULL, **IndexedFaceSet** uses the indices in its **coordIndex** field to specify the polygonal faces by connecting together points from the **coord** field. An index of -1 shall indicate that the current face has ended and the next one begins. The last face may be followed by a -1. **IndexedFaceSet** shall be specified in the local coordinate system and shall be affected by parent transformations.

The **coord** field specifies the vertices of the face set and is specified by **Coordinate** node.

If the **coordIndex** field is not NULL, the indices of the **coordIndex** field shall be used to specify the faces by connecting together points from the **coord** field. An index of -1 shall indicate that the current face has ended and the next one begins. The last face may be followed by a -1.

If the **coordIndex** field is NULL, the vertices of the **coord** field are laid out in their respective order to specify one face.

If the **color** field is NULL and there is a **Material** node defined for the **Appearance** affecting this **IndexedFaceSet**, then the **emissiveColor** of the **Material** node shall be used to draw the faces.

9.4.2.59 IndexedFaceSet2D

9.4.2.59.1 Node interface

| | |
|---------------------------|---------|
| IndexedFaceSet2D { | |
| eventIn | MFInt32 |
| eventIn | MFInt32 |
| eventIn | MFInt32 |
| exposedField | SFNode |
| exposedField | SFNode |
| exposedField | SFNode |
| field | MFInt32 |
| field | SFBool |
| field | SFBool |
| field | MFInt32 |
| field | MFInt32 |
| set_colorIndex | |
| set_coordIndex | |
| set_texCoordIndex | |
| color | NULL |
| coord | NULL |
| texCoord | NULL |
| colorIndex | [] |
| colorPerVertex | TRUE |
| convex | TRUE |
| coordIndex | [] |
| texCoordIndex | [] |

}

NOTE — For the binary encoding of this node see Annex [H.1.49](#).

9.4.2.59.2 Functionality and semantics

The **IndexedFaceSet2D** node is the 2D equivalent of the **IndexedFaceSet** node as defined in 9.4.2.58. The **IndexedFaceSet2D** node represents a 2D shape formed by constructing 2D faces (polygons) from 2D vertices (points) specified in the **coord** field. The **coord** field contains a **Coordinate2D** node that defines the 2D vertices, referenced by the **coordIndex** field. The faces of an **IndexedFaceSet2D** node shall not overlap each other.

The detailed semantics are identical to those for the **IndexedFaceSet** node (see 9.4.2.58), restricted to the 2D case, and with the additional differences described here.

If the **texCoord** field is NULL, a default texture coordinate mapping is calculated using the local 2D coordinate system bounding box of the 2D shape, as follows. The X dimension of the bounding box defines the S coordinates, and the Y dimension defines the T coordinates. The value of the S coordinate ranges from 0 to 1, from the left end of the bounding box to the right end. The value of the T coordinate ranges from 0 to 1, from the lower end of the bounding box to the top end. Figure 23 illustrates the default texture mapping coordinates for a simple **IndexedFaceSet2D** shape consisting of a single polygonal face.

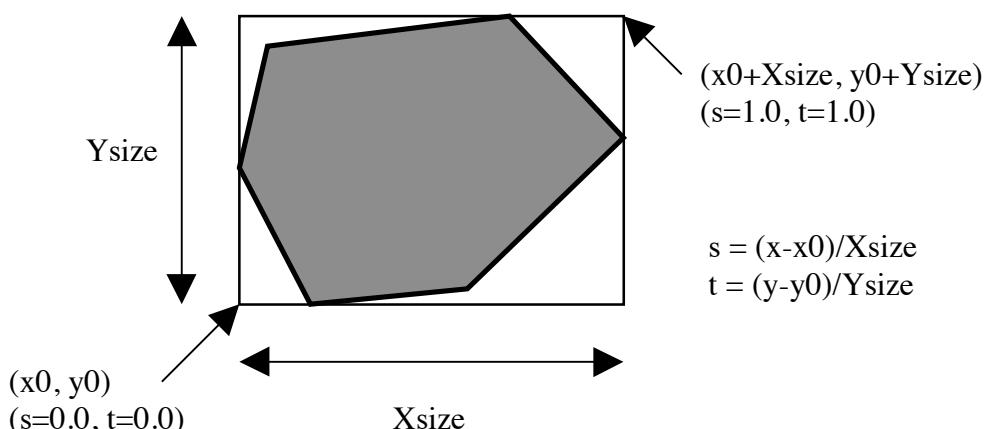


Figure 23 - **IndexedFaceSet2D** default texture mapping coordinates for a simple shape

9.4.2.60 IndexedLineSet

9.4.2.60.1 Node interface

| | | | |
|-------------------------|---------|-----------------------|------|
| IndexedLineSet { | | | |
| eventIn | MFInt32 | set_colorIndex | |
| eventIn | MFInt32 | set_coordIndex | |
| exposedField | SFNode | color | NULL |
| exposedField | SFNode | coord | NULL |
| field | MFInt32 | colorIndex | [] |
| field | SFBool | colorPerVertex | TRUE |
| field | MFInt32 | coordIndex | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.50](#).

9.4.2.60.2 Functionality and semantics

The semantics of the **IndexedLineSet** node are specified in ISO/IEC 14772-1:1998, subclause 6.24.

9.4.2.61 IndexedLineSet2D

9.4.2.61.1 Node interface

| | | | |
|---------------------------|---------|-----------------------|------|
| IndexedLineSet2D { | | | |
| eventIn | MFInt32 | set_colorIndex | |
| eventIn | MFInt32 | set_coordIndex | |
| exposedField | SFNode | color | NULL |
| exposedField | SFNode | coord | NULL |
| field | MFInt32 | colorIndex | [] |
| field | SFBool | colorPerVertex | TRUE |
| field | MFInt32 | coordIndex | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.51](#).

9.4.2.61.2 Functionality and semantics

The **IndexedLineSet2D** node specifies a collection of lines or polygons.

The **coord** field shall list the vertices of the lines. When **coordIndex** is empty, the order of vertices shall be assumed to be sequential in the **coord** field. Otherwise, the **coordIndex** field determines the ordering of the vertices, with an index of -1 representing an end to the current polyline.

If the **color** field is not NULL, it shall contain a **Color** node, and the colors are applied to the line(s) as with the **IndexedLineSet** node (see 9.4.2.60).

9.4.2.62 Inline

9.4.2.62.1 Node interface

| | | | |
|-----------------|----------|------------|----|
| Inline { | | | |
| exposedField | MFString | url | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.52](#).

9.4.2.62.2 Functionality and semantics

The semantics of the **Inline** node are specified in ISO/IEC 14772-1:1998, subclause 6.25. ISO/IEC 14496-1 does not support the bounding box parameters (**bboxCenter** and **bboxSize**).

The **url** field specifies the data source to be used (see 9.2.2.7.1). The external source must contain a valid BIFS scene, and may include BIFS-Commands and BIFS-Anim frames.

9.4.2.63 Layer2D

9.4.2.63.1 Node interface

| | | | |
|------------------|---------|-----------------------|--------|
| Layer2D { | | | |
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | NULL |
| exposedField | SFVec2f | size | -1, -1 |
| exposedField | SFNode | background | NULL |
| exposedField | SFNode | viewport | NULL |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.53](#).

9.4.2.63.2 Functionality and semantics

The **Layer2D** node is a transparent rendering rectangle region on the screen where a 2D scene is drawn. The rectangle always faces the viewer of the scene. **Layer2D** and **Layer3D** nodes enable the composition of multiple 2D and 3D scenes (see Figure 24).

EXAMPLE — This allows users to have 2D interfaces to a 2D scene, or 3D interfaces to a 2D scene, or to view a 3D scene from different viewpoints in the same scene.

The **addChildren** eventIn specifies a list of 2D nodes that shall be added to the **Layer2D's children** field.

The **removeChildren** eventIn specifies a list of 2D nodes that shall be removed from the **Layer2D's children** field.

The **children** field may contain any 2D children nodes that define a 2D scene. Layer nodes are considered to be 2D objects within the scene. The layering of the 2D and 3D layers is specified by any relevant transformations in the scene graph. The **Layer2D** node is composed with its center at the origin of the local coordinate system and shall not be present in 3D contexts (see 9.2.2.1).

The **size** parameter shall be a floating point number that expresses the width and height of the layer in the units of the local coordinate system. In case of a layer at the root of the hierarchy, the size is expressed in terms of the default 2D coordinate system (see 9.2.2.2). A size of -1 in either direction, means that the **Layer2D** node is not specified in size in that direction, and that the size is adjusted to the size of the parent layer, or the global rendering area dimension if the layer is on the top of the hierarchy. In the case where a 2D scene or object is shared between several **Layer2D** nodes, the behaviours are defined exactly as for objects that are multiply referenced using the DEF/USE mechanism. A sensor triggers an event whenever the sensor is triggered in any of the **Layer2D** in which it is contained. The behaviors triggered by the shared sensors as well as other behaviors that apply on objects shared between several layers apply on all layers containing these objects.

A **Layer2D** stores the stack of bindable children nodes that can affect the children scene of the layer. All relevant bindable children nodes have a corresponding exposedField in the **Layer2D** node. During presentation, these fields take the value of the currently bound bindable children node for the scene that is a child of the **Layer2D** node. Initially, the bound bindable children node is the corresponding field value of the **Layer2D** node if it is defined. If the field is undefined, the first bindable children node defined in the child scene will be bound. When the binding mechanism of the bindable children node is used (**set_bind** field set to TRUE), all the parent layers containing this node set the corresponding field to the current bound node value. It is therefore possible to share scenes across layers, and to have different bound nodes active, or to trigger a change of bindable children node for all layers containing a given bindable children node. For 2D scenes, the **background** field specifies the bound **Background2D** node. The **viewport** field is reserved for future extensions for 2D scenes.

All the 2D objects contained in a single **Layer2D** node form a single composed object. This composed object is considered by other elements of the scene to be a single object. In other words, if a **Layer2D** node, A, is the parent of two objects, B and C, layered one on top of the other, it will not be possible to insert a new object, D, between B and C unless D is added as a child of A.

Layers are transparent to user input, which means that if two layers are overlapping at a given location on the screen, a user input will affect both layers, regardless of which is drawn on top of the other. For instance, if two buttons placed in two different layers are overlapping, the click of the user at the location of the topmost button will also affect the button contained in the layer behind. Authors should carefully design behaviors in the overlapping layers.

EXAMPLE — In the following example, the same scene is used in two different **Layer2D** nodes. However, one scene is initially viewed with background b1, the other with background b2. When the user clicks on the button1 object, all layers are set with background b3.

```
OrderedGroup{
    children [
        Transform2D { # A set of transforms to translate and scale the layer
            ...
            children [
                Layer2D {
                    background DEF b1 Background2D {...}
                    # It is possible to define the bindable children node directly in
                    # the corresponding field
                    children [
                        DEF MYSCENE Transform2D {
                            children [
                                DEF b3 Background2D {...} # A shared background
                                DEF TS TouchSensor{}
                                DEF button1 Shape{..} # The button 1
                                    # The objects of my scene
                            ]
                        }
                    ]
                }
            ]
        }
    Transform2D {
        # Another set of transforms to translate and scale the layer
        children [
            Layer2D {
                children [
                    DEF b2 Background2D{...} # It is possible to define the bindable
                    # children node in the children field.
                    # b2 is initially bound since it is the
                    # first background 2D in the children
                    # field OF the parent Layer2d
                    Transform2D USE MYSCENE
                ]
            }
        ]
    }
}

ROUTE TS.isActive TO b3.set_bind
```

9.4.2.64 Layer3D

9.4.2.64.1 Node interface

| Layer3D { | | | |
|--------------|---------|-----------------------|--------|
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | NULL |
| exposedField | SFVec2f | size | -1, -1 |
| exposedField | SFNode | background | NULL |
| exposedField | SFNode | fog | NULL |
| exposedField | SFNode | navigationInfo | NULL |
| exposedField | SFNode | viewpoint | NULL |

NOTE — For the binary encoding of this node see Annex [H.1.54](#).

9.4.2.64.2 Functionality and semantics

The **Layer3D** node is a transparent, rectangular rendering region where a 3D scene is drawn. The **Layer3D** node may be composed in the same manner as any other 2D node. It represents a rectangular region on the screen facing the viewer. The basic **Layer3D** semantics are identical to those for **Layer2D** (see 9.4.2.63) but with 3D (rather than 2D) children. In general, **Layer3D** nodes shall not be present in 3D co-ordinate systems. The permitted exception to this is when a **Layer3D** node is the "top" node that begins a 3D scene or context (see 9.2.2.1).

The following fields specify bindable children nodes for **Layer3D**:

- **background** for **Background** nodes
- **fog** for **Fog** nodes
- **navigationInfo** for **NavigationInfo** nodes
- **viewpoint** for **Viewpoint** nodes

The **viewpoint** field can be used to allow the viewing of the same scene with several viewpoints.

NOTE — The rule for transparency to behaviors is also true for navigation in **Layer3D**. Authors should carefully design the various **Layer3D** nodes in a given scene to take account of navigation. Overlapping several **Layer3D** with navigation turned on may trigger strange navigation effects which are difficult to control by the user. Unless it is a feature of the content, navigation can be easily turned off using the **NavigationInfo** type field, or **Layer3D**'s can be designed not to be superimposed.

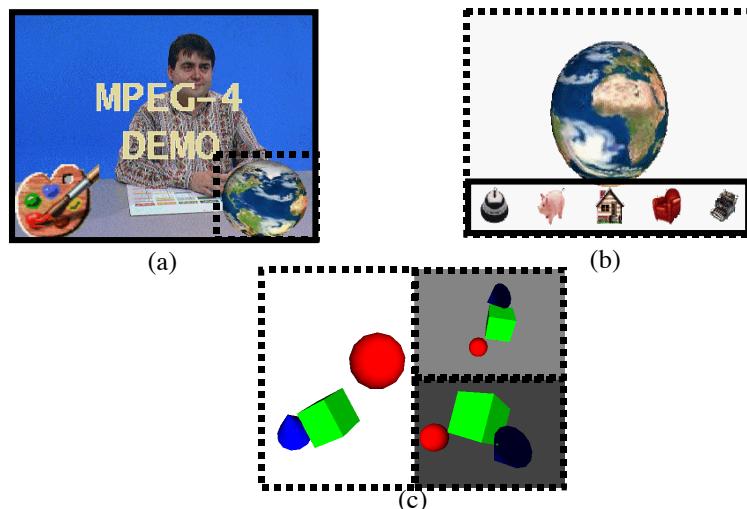


Figure 24 - Three Layer2D and Layer3D examples composed in a 2D space.

Layer2D's are indicated by a continuous line; **Layer3D**'s by a dashed line. Image (a) shows a **Layer3D** containing a 3D view of the earth on top of a **Layer2D** composed of a video, a logo and a text. Image (b) shows a **Layer3D** of the earth with a **Layer2D** containing various icons on top. Image (c) shows 3 views of a 3D scene with 3 non-overlapping **Layer3D**.

9.4.2.65 Layout

9.4.2.65.1 Node interface

| | | | |
|-----------------|----------|-----------------------|-----------|
| Layout { | | | |
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | SFBool | wrap | FALSE |
| exposedField | SFVec2f | size | -1, -1 |
| exposedField | SFBool | horizontal | TRUE |
| exposedField | MFString | justify | ["BEGIN"] |
| exposedField | SFBool | leftToRight | TRUE |
| exposedField | SFBool | topToBottom | TRUE |
| exposedField | SFFloat | spacing | 1.0 |
| exposedField | SFBool | smoothScroll | FALSE |
| exposedField | SFBool | loop | FALSE |
| exposedField | SFBool | scrollVertical | TRUE |
| exposedField | SFFloat | scrollRate | 0.0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.55](#).

9.4.2.65.2 Functionality and semantics

The **Layout** node specifies the placement (layout) of its children in various alignment modes as specified. For text children, this is by their **fontStyle** fields, and for non-text children by the fields **horizontal**, **justify**, **leftToRight**, **topToBottom** and **spacing** present in this node. It also provides the functionality of scrolling its children horizontally or vertically.

The **children** field shall specify a list of nodes that are to be arranged. Note that the children's position is implicit and that order is important.

The **wrap** field specifies whether children are allowed to wrap to the next row (or column in vertical alignment cases) after the edge of the layout frame is reached. If **wrap** is set to TRUE, children that would be positioned across or past the frame boundary are wrapped (vertically or horizontally) to the next row or column. If **wrap** is set to FALSE, children are placed in a single row or column that is clipped if it is larger than the layout.

When **wrap** is TRUE, if text objects larger than the layout frame need to be placed, these texts shall be broken down into pieces that are smaller than the layout. The preferred places for breaking text are spaces, tabs, hyphens, carriage returns and line feeds. When there is no such character in the texts to be broken, the texts shall be broken at the last character that is entirely placed in the layout frame.

The **size** field specifies the width and height of the layout frame.

The **horizontal**, **justify**, **leftToRight**, **topToBottom** and **spacing** fields have the same meaning as in the **FontStyle** node (see 9.4.2.53).

The **scrollRate** field specifies the scroll rate in meters per second. When **scrollRate** is zero, then there is no scrolling and the remaining scroll-related fields are ignored.

The **smoothScroll** field selects between smooth and line-by-line/character-by-character scrolling of children. When TRUE, smooth scroll is applied.

The **loop** field specifies continuous looping of children when set to TRUE. When **loop** is FALSE, child nodes that have scrolled out of the scroll layout frame will be deleted. When **loop** is TRUE, then the set of children scrolls continuously, wrapping around when they have scrolled out of the layout area. If the set of children is smaller than the layout area, some empty space will be scrolled with the children. If the set of children is bigger than the layout area, then only some of the children will be displayed at any point in time. When **scrollVertical** is TRUE and **loop** is TRUE and **scrollRate** is negative (top-to-bottom scrolling), then the bottom-most object will reappear on top of the layout frame as soon as the top-most object has scrolled entirely into the layout frame.

The **scrollVertical** field specifies whether the scrolling is done vertically or horizontally. When set to TRUE, the scrolling rate shall be interpreted as a vertical scrolling rate and a positive rate shall be interpreted as scrolling towards the top. When set to FALSE, the scrolling rate shall be interpreted as a horizontal scrolling rate and a positive rate shall mean scrolling to the right.

Objects are placed one by one, in the order they are given in the children list. Text objects are placed according to the **horizontal**, **justify**, **leftToRight**, **topToBottom** and **spacing** fields of their **FontStyle** node. Other objects are placed according to the same fields of the **Layout** node. The reference point for the placement of an object is the reference point as left by the placement of the previous object in the list.

In the case of vertical alignment, objects may be placed with respect to their top, bottom, center or baseline. The baseline of non-text objects is the same as their bottom.

Spacing shall be coherent only within sequences of objects with the same orientation (same value of **horizontal** field). The notions of top edge, bottom edge, base line, vertical center, left edge, right edge, horizontal center, line height and row width shall have a single meaning over coherent sequences of objects. This means that over a sequence of objects where **horizontal** is TRUE, **topToBottom** is TRUE and **spacing** has the same value, then the vertical size of the lines is computed as follows:

- maxAscent is the maximum of the ascent on all text objects.
- maxDescent is the maximum of the descent on all text objects.
- maxHeight is the maximum height of non-text objects.

If the minor mode in the **justify** field of the layout is FIRST (baseline alignment), then the non-text objects shall be aligned on the baseline, which means the vertical size of the line is:

$$\text{size} = \max(\text{maxAscent}, \text{maxHeight}) + \text{maxDescent}$$

If the minor mode in the justify field of the layout is any other value, then the non-text objects shall be aligned with respect to the top, bottom or center, which means the size of the line is:

$$\text{size} = \max(\text{maxAscent} + \text{maxDescent}, \text{maxHeight})$$

The first line is placed with its top edge flush to the top edge of the layout; the base line is placed maxAscent units lower, and the bottom edge is placed maxDescent units lower. The center line is in the middle, between the top and bottom edges. The top edges of subsequent lines are placed at regular intervals of value spacing \times size.

The other cases can be inferred from the above description. When the orientation is vertical, then the baseline, ascent and descent are not useful for the computation of the width of the rows. All objects only have a width. Column size is the maximum width over all objects.

EXAMPLE —

If **wrap** is FALSE:

- a) If **horizontal** is TRUE, then objects are placed in a single line. The layout direction is given by the **leftToRight** field. Horizontal alignment in the row is done according to the first argument in **justify** (major mode = flush left, flush right, centered), and vertical alignment is done according to the second argument in **justify** (minor mode = flush top, flush bottom, flush baseline, centered). The **topToBottom** field is meaningless in this configuration.
- b) If **horizontal** is FALSE, then objects are placed in a single column. The layout direction is given by the **topToBottom** field. Vertical alignment in the column is done according to the first argument in **justify** (major mode), and horizontal alignment is done according to the second argument in **justify** (minor mode).

If **wrap** is TRUE:

- a) If **horizontal** is TRUE, then objects are placed in multiple lines. The layout direction is given by the **leftToRight** field. The wrapping direction is given by the **topToBottom** field. Horizontal alignment in the lines is done according to the first argument in **justify** (major mode), and vertical alignment is done according to the second argument in **justify** (minor mode).

- b) If **horizontal** is FALSE, then objects are placed in multiple column. The layout direction is given by the **topToBottom** field. The wrapping direction is given by the **leftToRight** field. Vertical alignment in the columns is done according to the first argument in **justify** (major mode), and horizontal alignment is done according to the second argument in **justify** (minor mode).

If **scrollRate** is zero, then the **Layout** is static and positions change only when children are modified.

If **scrollRate** is non-zero, then the position of the children is updated according to the values of **scrollVertical**, **scrollRate**, **smoothScroll** and **loop**.

If **scrollVertical** is TRUE, then if **scrollRate** is positive, then the scrolling direction is left-to-right, and vice-versa.

If **scrollVertical** is FALSE, then if **scrollRate** is positive, then the scrolling direction is bottom-to-top, and vice-versa.

9.4.2.66 LineProperties

9.4.2.66.1 Node interface

```
LineProperties {
    exposedField SFColor      lineColor          0, 0, 0
    exposedField SFInt32       lineStyle         0
    exposedField SFFloat        width            1.0
}
```

NOTE — For the binary encoding of this node see Annex [H.1.56](#).

9.4.2.66.2 Functionality and semantics

The **LineProperties** node specifies line parameters used in 2D and 3D rendering.

The **lineColor** field specifies the color with which to draw the lines and outlines of 2D geometries.

The **lineStyle** field shall contain the line style type to apply to lines. The allowed values are:

Table 37 - lineStyle description

| lineStyle | Description |
|------------------|--------------------|
| 0 | solid |
| 1 | dash |
| 2 | dot |
| 3 | dash-dot |
| 4 | dash-dash-dot |
| 5 | dash-dot-dot |

The terminal shall draw each line style in a manner that is distinguishable from each other line style.

The **width** field determines the width, in the local coordinate system, of rendered lines. The apparent width depends on the local transformation.

The cap and join style to be used are as follows. The wide lines should end with a square form flush with the end of the lines. The join style is described in Figure 25.

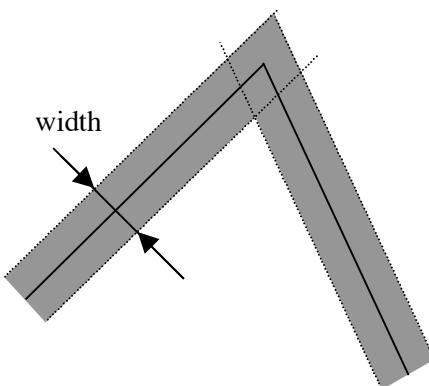


Figure 25 - Cap and join style for LineProperties

9.4.2.67 ListeningPoint

9.4.2.67.1 Node interface

```
ListeningPoint {
    eventIn      SFBool      set_bind
    exposedField SFBool      jump           TRUE
    exposedField SFRotation orientation   0, 0, 1, 0
    exposedField SFVec3f    position       0, 0, 10
    field        SFString   description   ""
    eventOut     SFTime     bindTime
    eventOut     SFBool     isBound
}
```

NOTE — For the binary encoding of this node see Annex [H.1.57](#).

9.4.2.67.2 Functionality and semantics

The **ListeningPoint** node specifies the reference position and orientation for spatial audio presentation. If there is no **ListeningPoint** given in a scene, the apparent listener position is slaved to the active **ViewPoint**.

The semantics are identical to those of the **Viewpoint** node (see 9.4.2.109).

9.4.2.68 LOD

9.4.2.68.1 Node interface

```
LOD {
    exposedField MFNode    level          []
    field        SFVec3f   center        0, 0, 0
    field        MFFloat   range         []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.58](#).

9.4.2.68.2 Functionality and semantics

The semantics of the **LOD** node are specified in ISO/IEC 14772-1:1998, subclause 6.26.

9.4.2.69 Material

9.4.2.69.1 Node interface

```
Material {
    exposedField SFFloat  ambientIntensity 0.2
    exposedField SFColor  diffuseColor     0.8, 0.8, 0.8
    exposedField SFColor  emissiveColor   0, 0, 0
```

| | | | |
|--------------|---------|----------------------|---------|
| exposedField | SFFloat | shininess | 0.2 |
| exposedField | SFColor | specularColor | 0, 0, 0 |
| exposedField | SFFloat | transparency | 0.0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.59](#).

9.4.2.69.2 Functionality and semantics

The semantics of the **Material** node are specified in ISO/IEC 14772-1:1998, subclause 6.27.

9.4.2.70 Material2D

9.4.2.70.1 Node interface

| | | | |
|---------------------|---------|----------------------|---------------|
| Material2D { | | | |
| exposedField | SFColor | emissiveColor | 0.8, 0.8, 0.8 |
| exposedField | SFBool | filled | FALSE |
| exposedField | SFNode | lineProps | NULL |
| exposedField | SFFloat | transparency | 0.0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.60](#).

9.4.2.70.2 Functionality and semantics

The **Material2D** node specifies the characteristics of a rendered 2D **Shape**. Material2D shall be used as the material field of an Appearance node in certain circumstances (see 9.4.2.5.2)

The **emissiveColor** field specifies the color of the 2D **Shape**. If the shape is not filled, the interior is not drawn.

The **filled** field specifies whether rendered nodes are filled or drawn using lines. This field affects **IndexedFaceSet2D**, **Circle** and **Rectangle** nodes. If the rendered node is not filled the line shall be drawn centered on the rendered node outline. That means that half the line will fall inside the rendered node, and the other half outside.

The **lineProps** field contains information about line rendering in the form of a **LineProperties** node. If the field is null the line properties take on a default behaviour identical to the default settings of the **LineProperties** node. When **filled** is true, if **lineProps** is null, no outline is drawn; if **lineProps** is non null, an outline is drawn using **lineProps** information. When **filled** is false and **lineProps** is null, an outline is drawn with default width (1), default style (solid) and as line color the emissive color of the Material2D. When **filled** is false and **lineProps** is defined, line color, width and style, whether explicitly specified or default values, are taken from the **lineProps** node. See 9.4.2.66 for more information on **LineProperties**.

The **transparency** field specifies the transparency of the 2D **Shape**.

9.4.2.71 MaterialKey

9.4.2.71.1 Node interface

| | | | |
|----------------------|---------|----------------------|---------|
| MaterialKey { | | | |
| exposedField | SFBool | isKeyed | TRUE |
| exposedField | SFBool | isRGB | TRUE |
| exposedField | SFColor | keyColor | 0, 0, 0 |
| exposedField | SFFloat | lowThreshold | 0 |
| exposedField | SFFloat | highThreshold | 0 |
| exposedField | SFFloat | transparency | 0 |
| } | | | |

NOTE - For the binary encoding of this node see Annex [H.3.11](#).

9.4.2.71.2 Functionality and semantics

The **MaterialKey** node can be used in the material field of the **Appearance** node, which only appears in the **appearance** field of a **Shape** node. It can be used when the texture of the **Shape** node is defined by either an image (**ImageTexture** or **PixelTexture**) or a video sequence (**MovieTexture**). Its functionality is similar to the **Material2D** node, but is specific to the BitMap geometry, so it does not include the line properties functionality. It generates a shape mask, based on a color and the threshold values defined in the node. It also defines a transparency value, which will behave identically to the transparency values in both **Material** and **Material2D**, except that it applies only to the visible part of the shape.

The fields of the **MaterialKey** node are defined as follows:

- The **isKeyed** field specifies whether the keying functionality is enabled or disabled.
- The **isRGB** field allows the content author to choose which color space they wish to define the keying in, either RGB or YUV.
- The **keyColor** field specifies the reference color used for keying of shape.
- The **lowThreshold** field defines the magnitude of the variance from the exact key value for which the pixel will be considered completely transparent.
- The **highThreshold** field defines the magnitude of the variance from the exact key value for which the pixel will be considered opaque (visible).
- The **transparency** field defines the level of transparency assigned to the opaque or visible region of the shape.
- An example implementation of **MaterialKey** is given in Annex N.

9.4.2.72 MovieTexture

9.4.2.72.1 Node interface

| MovieTexture { | | | |
|-----------------------|----------|-------------------------|-------|
| exposedField | SFBool | loop | FALSE |
| exposedField | SFFloat | speed | 1.0 |
| exposedField | SFTime | startTime | 0 |
| exposedField | SFTime | stopTime | 0 |
| exposedField | MFString | url | [] |
| field | SFBool | repeatS | TRUE |
| field | SFBool | repeatT | TRUE |
| eventOut | SFTime | duration_changed | |
| eventOut | SFBool | isActive | |

}

NOTE — For the binary encoding of this node see Annex [H.1.61](#).

9.4.2.72.2 Functionality and semantics

The **loop**, **startTime**, and **stopTime** exposedFields and the **isActive** eventOut, and their effects on the **MovieTexture** node, are described in 9.2.1.6.1.

The **speed** exposedField controls playback speed. It does not affect the delivery of the stream attached to the **MovieTexture** node. For streaming media, value of **speed** other than 1 shall be ignored.

A **MovieTexture** shall display frame or VOP 0 if **speed** is 0. For positive values of **speed**, the frame or VOP that an active **MovieTexture** will display at time *now* corresponds to the frame or VOP at movie time (i.e., in the movie's local time base with frame or VOP 0 at time 0, at speed = 1):

$$\text{fmod}(\text{now} - \text{startTime}, \text{duration}/\text{speed})$$

If **speed** is negative, then the frame or VOP to display is the frame or VOP at movie time:

duration + fmod(now - **startTime**, duration/**speed**).

A **MovieTexture** node is inactive before **startTime** is reached. If **speed** is non-negative, then the first VOP shall be used as texture, if it is already available. If **speed** is negative, then the last VOP shall be used as texture, if it is already available.

When a **MovieTexture** becomes inactive, the VOP corresponding to the time at which the **MovieTexture** became inactive shall persist as the texture. The **speed** exposedField indicates how fast the movie shall be played. A speed of 2 indicates the movie plays twice as fast. Note that the **duration_changed** eventOut is not affected by the **speed** exposedField. **set_speed** events shall be ignored while the movie is playing.

The **url** field specifies the data source to be used (see 9.2.2.7.1).

9.4.2.73 NavigationInfo

9.4.2.73.1 Node interface

NavigationInfo {

| | | | |
|--------------|----------|------------------------|-------------------|
| eventIn | SFBool | set_bind | |
| exposedField | MFFloat | avatarSize | [0.25, 1.6, 0.75] |
| exposedField | SFBool | headlight | TRUE |
| exposedField | SFFloat | speed | 1.0 |
| exposedField | MFString | type | ["WALK", "ANY"] |
| exposedField | SFFloat | visibilityLimit | 0.0 |
| eventOut | SFBool | isBound | |

}

NOTE — For the binary encoding of this node see Annex [H.1.62](#).

9.4.2.73.2 Functionality and semantics

The semantics of **NavigationInfo** are specified in ISO/IEC 14772-1:1998, subclause 6.29.

9.4.2.74 Normal

9.4.2.74.1 Node interface

Normal {

| | | | |
|--------------|---------|---------------|----|
| exposedField | MFVec3f | vector | [] |
|--------------|---------|---------------|----|

NOTE — For the binary encoding of this node see Annex [H.1.63](#).

9.4.2.74.2 Functionality and semantics

The semantics of the **Normal** node are specified in ISO/IEC 14772-1:1998, subclause 6.30.

9.4.2.75 NormallInterpolator

9.4.2.75.1 Node interface

NormallInterpolator {

| | | | |
|--------------|---------|----------------------|----|
| eventIn | SFFloat | set_fraction | |
| exposedField | MFFloat | key | [] |
| exposedField | MFVec3f | keyValue | [] |
| eventOut | MFVec3f | value_changed | |

}

NOTE — For the binary encoding of this node see Annex [H.1.64](#).

9.4.2.75.2 Functionality and semantics

The semantics of the **NormalInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.31.

9.4.2.76 OrderedGroup

9.4.2.76.1 Node interface

| | | | |
|-----------------------|---------|-----------------------|----|
| OrderedGroup { | | | |
| eventIn | MFNode | addChildren | |
| eventIn | MFNode | removeChildren | |
| exposedField | MFNode | children | [] |
| exposedField | MFFloat | order | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.65](#).

9.4.2.76.2 Functionality and semantics

The **OrderedGroup** node controls the visual layering order of its children. When used as a child of a **Layer2D** node, it allows the control of which shapes obscure others. When used as a child of a **Layer3D** node, it allows content creators to specify the rendering order of elements of the scene that have identical z values. This allows conflicts between coplanar or close polygons to be resolved.

The **addChildren** eventIn specifies a list of objects that shall be added to the **OrderedGroup** node.

The **removeChildren** eventIn specifies a list of objects that shall be removed from the **OrderedGroup** node.

The **children** field is the current list of objects contained in the **OrderedGroup** node.

When the **order** field is empty (the default) children are layered in order, first child to last child, with the last child being rendered last. If the **order** field contains values, one value is assigned to each child. Entries in the **order** field array match the child in the corresponding element of the **children** field array. The child with the lowest order value is rendered before all others. The remaining children are rendered in increasing order. The child corresponding to the highest **order** value is rendered last.

Since 2D shapes have no z value, this is the sole determinant of the visual ordering of the shapes. However, when the **OrderedGroup** node is used with 3D shapes, its ordering mechanism shall be used in place of the natural z order of the shapes themselves. The resultant image shall show the shape with the highest **order** value on top, regardless of its z value. However, the resultant z-buffer contains a z value corresponding to the shape closest to the viewer at that pixel. The **order** shall be used to specify which geometry should be drawn first, to avoid conflicts between coplanar or close polygons.

NOTE — Content authors must use this functionality carefully since, depending on the **Viewpoint**, 3D shapes behind a given object in the natural z order may appear in front of this object.

9.4.2.77 OrientationInterpolator

9.4.2.77.1 Node interface

| | | | |
|----------------------------------|------------|----------------------|----|
| OrientationInterpolator { | | | |
| eventIn | SFFloat | set_fraction | |
| exposedField | MFFloat | key | |
| exposedField | MFRotation | keyValue | [] |
| eventOut | SFRotation | value_changed | [] |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.66](#).

9.4.2.77.2 Functionality and semantics

The semantics of the **OrientationInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.32.

9.4.2.78 PerceptualParameters

9.4.2.78.1 Node interface

PerceptualParameters {

| | | | |
|--------------|---------|----------------------------|---------------|
| exposedField | Float | sourcePresence | 1.0 |
| exposedField | Float | sourceWarmth | 1.0 |
| exposedField | Float | sourceBrilliance | 1.0 |
| exposedField | Float | roomPresence | 1.0 |
| exposedField | SFTime | runningReverberance | 1.0 |
| exposedField | Float | envelopment | 0.0 |
| exposedField | SFTime | lateReverberance | 1.0 |
| exposedField | Float | heavyness | 1.0 |
| exposedField | Float | liveness | 1.0 |
| exposedField | MFFloat | omniDirectivity | 1.0 |
| exposedField | MFFloat | directFilterGains | 1.0, 1.0, 1.0 |
| exposedField | MFFloat | inputFilterGains | 1.0, 1.0, 1.0 |
| exposedField | SFFloat | refDistance | 1.0 |
| exposedField | SFFloat | freqLow | 250.0 |
| exposedField | SFFloat | freqHigh | 4000.0 |
| exposedField | SFTime | timeLimit1 | 0.02 |
| exposedField | SFTime | timeLimit2 | 0.04 |
| exposedField | SFTime | timeLimit3 | 0.1 |
| exposedField | SFFloat | modalDensity | 0.8 |

}

NOTE - For the binary encoding of this node see Annex [H.3.12](#).

9.4.2.78.2 Functionality and Semantics

PerceptualParameters is a node that contains information about the perceptual properties of **DirectiveSound** objects to be processed in the same auralization process when the perceptual rendering is desired. It contains a set of nine perceptual parameters that characterizes, for a given reference distance **refDistance** and for non-directive sounds, the acoustic to be rendered in the virtual scene. In addition it allows for physical-like effects such as transmission through a wall from another room (with **inputFilterGains**) or occlusion/diffraction of the direct path by an obstacle (with **directFilterGains**). The directivity properties of the sound source is defined in the **directivity** fields in the **DirectiveSound** node level and in **omniDirectivity** field of this node for an arbitrary amount of azimuth angles from the front (defined in the **direction** field at the **DirectiveSound** node level) to the back of the sound source.

Generic reverberation response model:

The perceptual model is based on a temporal division of the reverberation response into four sections (see Figure 26):

- direct sound (R_0)
- directional early reflections (R_1)
- diffuse early reflections (R_2)
- diffuse late reverberation (R_3)

These four sections are separated by temporal limits (denoted t_0, t_1, t_2, t_3), and characterized by their energies in 3 frequency bands (low, mid, high). These frequency bands are separated by two cross-over frequencies denoted f_{low} and f_{high} .

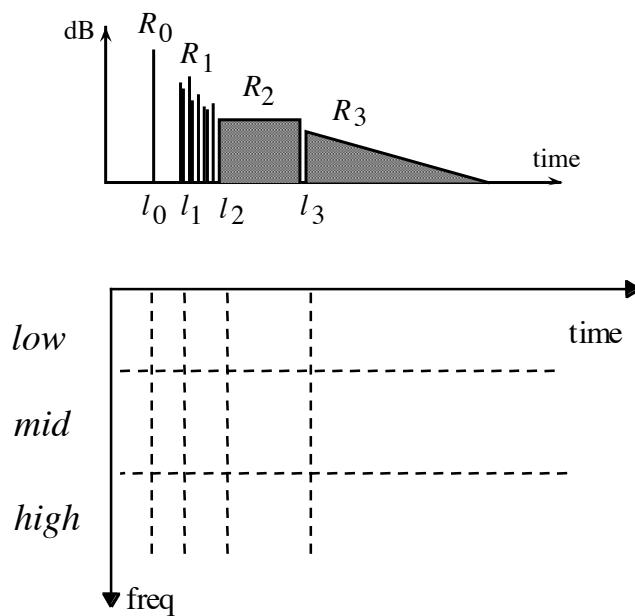


Figure 26 - Generic reverberation response model. R_0 represents the direct sound, R_1 the directional early reflections, R_2 the diffuse reflections, ad R_3 the exponentially decaying, diffuse late reverberation.

Based on the above model, the reverberation response is completely characterized by the following set of parameters:

| | |
|---------------------|---------------------------------------|
| energies | R_0, R_1, R_2, R_3 (low, mid, high) |
| decay time | Rt (low, mid, high) |
| temporal parameters | l_0, l_1, l_2, l_3 + modal density |
| frequencies | f_{low}, f_{high} |

The modal density is defined as the number of modes per Hz. This parameter is useful for the design and control of artificial reverberation algorithms based on recursive (IIR) digital filter structures.

High-level (perceptual) parameters:

In the perceptual acoustics rendering nine orthogonal perceptual parameters that directly relate to the audible sensations, are used to define the acoustic response for each sound source. A measurable acoustical criterion is defined for each perceptual factor. These objective criteria represent an attempt to provide an exhaustive characterization of room acoustical quality in concert halls, opera houses and auditoria, by use of a minimal set of independent parameters. They can be expressed from energetic measures derived from a decomposition of the impulse response in three frequency bands and four temporal sections (see Figure 26), assuming time limits l_1, l_2, l_3 respectively equal to 20, 40, 100 ms relative to the time of arrival of the direct sound l_0 , and with a dependence on the directional distribution of early reflections.

The nine perceptual factors that have been determined in the experiments are denominated as follows, and can be divided in three groups:

Three perceptual factors describe effects which are characteristic of the room (the corresponding objective criteria are indicated in parentheses):

- late reverberance (late decay time)
- heaviness and liveness (variation of decay time with frequency)

The six other factors describe effects that depend of the position, directivity and orientation of the source. The first three are perceived as characteristics of the source, while the remaining three are perceptually associated with the room:

- source presence (energy of the direct sound and early room effect)
- brilliance and warmth (variation of early energy with frequency)
- room presence (energy of late room effect)
- running reverberance (early decay time)
- envelopment (energy of early room effect relative to direct sound)

A variation of the source presence creates a convincing effect of proximity or remoteness of the sound source. The term "reverberance" refers to the sensation that sounds are prolonged by the room reverberation. Late reverberance differs from running reverberance by the fact that it is essentially perceived during interruptions of the sound radiated by the source, for example when the source falls silent. Running reverberance, on the contrary, remains perceived during continuous music.

- **sourcePresence** field indicates the total absolute energy of the R1 in the room acoustic response in Figure 26.
- **sourceWarmth** and **sourceBrilliance** fields are used for calculation of energies of R1 at the frequency limits **freqLow**, and **freqHigh**.
- **roomPresence** is the total absolute energy of R3 in Figure 26.
- **runningReverberance** is a relative early decay time (with respect to its minimum and maximum values). It is used to compute the absolute value of the decay time in seconds from its variation boundaries as explained below.
- **envelopment** is the ratio between R1 and R0. This value is relative with respect to its variation boundaries.
- **heaviness** and **liveness** define the decay time as a function of frequency. They are used in the computation of the late reverberance at the different frequency bands defined by **freqLow** and **freqHigh**.

omniDirectivity is the diffuse-field spectrum for the source required in the Room processor. This will be called the omnidirectional directivity because it defines the directivity of an “equivalent omnidirectional source” (equivalent with regards to the reverberation, but not the direct path). It could be derived from the **directivity** field as defined in the **DirectiveSound** node by averaging the radiated power over all directions around the source. However, it is simpler and more reliable to transmit it separately in the bitstream. The same approach as for **directivity** is considered except that it doesn't depend on the angles.

The general form for the **omniDirectivity** field is:

[nf, freq₀, freq₁, ..., freq_{nf-1}, gain₀, gain₁, ..., gain_{nf-1}].

Where,

nf is the number of reference frequencies

freq_j is the jth reference frequency

gain_j is the linear gain for the jth reference frequency.

An example of **omniDirectivity** is given below:

[5, 250, 500, 1000, 2000, 4000,

0.9, 0.85, 0.7, 0.6, 0.55]

If not specified in the node, the default gains at 0 Hz is gain₀.

By default, the gain for frequencies above f_{nf-1} is **gain_{nf-1}**.

directFilterGains specifies a filter applied to the direct path only (power gains in the three frequency bands defined by the crossover frequencies **freqLow**, **freqHigh**).

inputFilterGains specifies a filter applied to the source signal similarly as **directFilterGains** for the direct path.

refDistance is a reference distance at which the above set of perceptual parameters is defined (in meters). If the distance in the scene is different from this value, it is used for calculating a new value for the **sourcePresence**.

The generic room response that is modeled in the perceptual approach is characterized in the frequency domain by two frequency limits, **freqLow** and **freqHigh** (see Figure 26). This generic room response is also characterized in the temporal domain by four time limits and by the modal density of the late reverb. The **PerceptualParameters** node contains **timeLimit1**, **timeLimit2**, **timeLimit3** which are the temporal limits l_1 , l_2 , l_3 (relative to l_0) and **modalDensity** (in seconds).

9.4.2.78.2.1 Mapping from high-level to low-level parameters

In order to use a reverberator to process the sound sources, it is necessary to convert from perceptual parameters to energetic parameters.

When an acoustical or perceptual criterion is updated at the higher level, the necessary modifications in the low-level energetic description of the room response can be readily computed via a nonlinear matrix inversion procedure (this is explained below). When the signal processing model is scaled down in order to reduce the computational cost, this is reflected in the behaviour of the perceptual control interface. For instance, if the *reverb* block is shared between several sources, the late decay time settings are constrained to be identical for these sources. If the *cluster* block is suppressed, the running reverberance and the room envelopment are no longer independently controllable.

When computing the energetic parameters of the room response, the perceptual parameters are denoted as follows :

Table 38 - Perceptual parameters

| Perceptual parameter field | Notation | Min | max |
|-----------------------------------|--------------------|------------|------------|
| sourcePresence | Es | 0.0 | 1.0 |
| sourceBrilliance | Desl | 0.1 | 10.0 |
| sourceWarmth | Desh | 0.1 | 10.0 |
| roomPresence | Rev | 0.0 | 1.0 |
| runningReverberance | Edt _{rel} | 0.0 | 0.1 |
| envelopment | Rdl _{rel} | 0.0 | 0.1 |
| lateReverberance | Rt (s) | 0.1 | 100.0 |
| heaviness | Drtl | 0.1 | 10.0 |
| liveness | Drth | 0.1 | 1.0 |

Es and Rev are absolute energies, and Edt_{rel} is a relative energy value. Desl, Desh, Drtl, Drth are multiplicative factors. Rt (reverberation time) is expressed in seconds, and Edt is a relative early decay time value.

With the above notations, the energetic factors are calculated as follows:

$$C = \text{pow}(10, -1.2 / Rt)$$

$$\text{if } Rev/Es <= 2 * (1+C)/(1-C)$$

R3= $(-C + \sqrt{ C^2 + 0.5 * Rev/Es * (1-C)^2 }) * 4 * Es / (1-C)^2$

else

R3= Rev + 2*Es

if (2*Es/R3 < 30.622)

Edt_{min}= 0.4 + Rt * [1 - 0.667*log10(1 + 2*Es/R3)]

else

Edt_{min}= 0.6 / log10(1 + 2*Es/R3)

if (Es/R3 < 30.622)

Edt_{max}= 0.4 + Rt * [1 - 0.667*log10(1 + Es/R3)]

else

Edt_{max}= 0.6 / log10(1 + Es/R3))

The early decay time in seconds is calculated as:

Edt= Edt_{min}+ (Edt_{max}- Edt_{min})*Edt_{rel}

If Edt > 0.4

R2 = -Es + R3 [pow(10, 1.5 * (1 + (0.4-Edt)/Rt)) -1]

else

R2 = -Es + R3 [pow(10, 0.6 / Edt) -1]

Rdl_{min} = 0.05*R2 /Es

Rdl_{max} = 0.27 + 0.05*R2 /Es

The absolute envelopment in seconds is computed as:

Rdl = Rdl_{min} + (Rdl_{max} - Rdl_{min})* Rdl_{rel}

R1= (Es*Rdl - 0.05*R2) / 0.3

R1_{low}= R1*Desl

R1_{high}= R1*Desh

R0= Es - R1

R0_{low}= R0*Desl

R0_{high}= R0*Desh

Rt_{low} = Drtl * Rt

Rt_{high} = Drth * Rt

NOTE - All the values are energies expressed in the linear domain

9.4.2.78.2.2 Mapping from positional to perceptual parameters

If the source is not placed at the reference distance d_{ref} for which the perceptual “preset” is defined, the following correction is applied (when **useAttenuation** is TRUE):

$E_s = E_s * [d / d_{ref}]^2$ where d is the actual distance between the source and the viewpoint. For an example implementation of perceptual approach, see Annex O.

9.4.2.79 PixelTexture

9.4.2.79.1 Node interface

| | | | |
|-----------------------|---------|----------------|-------|
| PixelTexture { | | | |
| exposedField field | SFImage | image | 0 0 0 |
| field | SFBool | repeatS | TRUE |
| field | SFBool | repeatT | TRUE |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.67](#).

9.4.2.79.2 Functionality and semantics

The semantics of the **PixelTexture** node are specified in ISO/IEC 14772-1:1998, subclause 6.33.

9.4.2.80 PlaneSensor

9.4.2.80.1 Node interface

| | | | |
|----------------------|---------|----------------------------|-------|
| PlaneSensor { | | | |
| exposedField | SFBool | autoOffset | TRUE |
| exposedField | SFBool | enabled | TRUE |
| exposedField | SFVec2f | maxPosition | -1 -1 |
| exposedField | SFVec2f | minPosition | 0 0 |
| exposedField | SFVec3f | offset | 0 0 0 |
| eventOut | SFBool | isActive | |
| eventOut | SFVec3f | trackPoint_changed | |
| eventOut | SFVec3f | translation_changed | |
| } | | | |

9.4.2.80.2 Functionality and semantics

The semantics of the **PlaneSensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.34.

9.4.2.81 PlaneSensor2D

9.4.2.81.1 Node interface

| | | | |
|------------------------|---------|----------------------------|------|
| PlaneSensor2D { | | | |
| exposedField | SFBool | autoOffset | TRUE |
| exposedField | SFBool | enabled | TRUE |
| exposedField | SFVec2f | maxPosition | 0, 0 |
| exposedField | SFVec2f | minPosition | 0, 0 |
| exposedField | SFVec2f | offset | 0, 0 |
| eventOut | SFBool | isActive | |
| eventOut | SFVec2f | trackPoint_changed | |
| eventOut | SFVec2f | translation_changed | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.68](#).

9.4.2.81.2 Functionality and semantics

This sensor detects pointer device dragging and enables the dragging of objects on the 2D rendering plane.

The semantics of **PlaneSensor2D** are a restricted case for 2D of the semantics for the **PlaneSensor** node (see 9.4.2.80).

9.4.2.82 PointLight

9.4.2.82.1 Node interface

| | | | |
|----------------------|--|-------------------------|---------|
| PointLight { | | | |
| exposedField SFFloat | | ambientIntensity | 0.0 |
| exposedField SFVec3f | | attenuation | 1, 0, 0 |
| exposedField SFColor | | color | 1, 1, 1 |
| exposedField SFFloat | | intensity | 1.0 |
| exposedField SFVec3f | | location | 0, 0, 0 |
| exposedField SFBool | | on | TRUE |
| exposedField SFFloat | | radius | 100.0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.69](#).

9.4.2.82.2 Functionality and semantics

The semantics of the **PointLight** node are specified in ISO/IEC 14772-1:1998, subclause 6.35.

9.4.2.83 PointSet

9.4.2.83.1 Node interface

| | | | |
|---------------------|--|--------------|------|
| PointSet { | | | |
| exposedField SFNode | | color | NULL |
| exposedField SFNode | | coord | NULL |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.70](#).

9.4.2.83.2 Functionality and semantics

The semantics of the **PointSet** node are specified in ISO/IEC 14772-1:1998, subclause 6.36.

9.4.2.84 PointSet2D

9.4.2.84.1 Node interface

| | | | |
|---------------------|--|--------------|------|
| PointSet2D { | | | |
| exposedField SFNode | | color | NULL |
| exposedField SFNode | | coord | NULL |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.71](#).

9.4.2.84.2 Functionality and semantics

This is a 2D equivalent of the **PointSet** node (see 9.4.2.83), with semantics that are the 2D restriction of that node.

9.4.2.85 PositionInterpolator

9.4.2.85.1 Node interface

```
PositionInterpolator {
    eventIn      SFFloat      set_fraction
    exposedField MFFloat     key
    exposedField MFVec3f    keyValue
    eventOut     SFVec3f    value_changed
}
```

NOTE — For the binary encoding of this node see Annex [H.1.72](#).

9.4.2.85.2 Functionality and semantics

The semantics of the **PositionInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.37.

9.4.2.86 PositionInterpolator2D

9.4.2.86.1 Node interface

```
PositionInterpolator2D {
    eventIn      SFFloat      set_fraction
    exposedField MFFloat     key
    exposedField MFVec2f    keyValue
    eventOut     SFVec2f    value_changed
}
```

NOTE — For the binary encoding of this node see Annex [H.1.73](#).

9.4.2.86.2 Functionality and semantics

This is a 2D equivalent of the **PositionInterpolator** node (see 9.4.2.85) with semantics that are the 2D restriction of that node.

9.4.2.87 ProximitySensor

9.4.2.87.1 Node interface

```
ProximitySensor {
    exposedField SFVec3f    center          0, 0, 0
    exposedField SFVec3f    size            0, 0, 0
    exposedField SFBool     enabled        TRUE
    eventOut     SFBool     isActive
    eventOut     SFVec3f    position_changed
    eventOut     SFRotation   orientation_changed
    eventOut     SFTime      enterTime
    eventOut     SFTime      exitTime
}
```

NOTE — For the binary encoding of this node see Annex [H.1.74](#).

9.4.2.87.2 Functionality and semantics

The semantics of the **ProximitySensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.38.

9.4.2.88 ProximitySensor2D

9.4.2.88.1 Node interface

```
ProximitySensor2D {
    exposedField SFVec2f    center          0, 0
    exposedField SFVec2f    size            0, 0
    exposedField SFBool     enabled        TRUE
}
```

```

eventOut    SFBool      isActive
eventOut    SFVec2f    position_changed
eventOut    SFFloat     orientation_changed
eventOut    SFTime      enterTime
eventOut    SFTime      exitTime
}

```

NOTE — For the binary encoding of this node see Annex [H.1.75](#).

9.4.2.88.2 Functionality and semantics

This is the 2D equivalent of the **ProximitySensor** node (see 9.4.2.87) with semantics that are the 2D restriction of the that node.

9.4.2.89 QuantizationParameter

9.4.2.89.1 Node interface

QuantizationParameter {

| | | | |
|-------|----------|--------------------------------|------------|
| field | SFBool | isLocal | FALSE |
| field | SFBool | position3DQuant | FALSE |
| field | SFVec3f | position3DMin | -∞, -∞, -∞ |
| field | SFVec3f | position3DMax | +∞, +∞, +∞ |
| field | SFIInt32 | position3DNbBits | 16 |
| field | SFBool | position2DQuant | FALSE |
| field | SFVec2f | position2DMin | -∞, -∞ |
| field | SFVec2f | position2DMax | +∞, +∞ |
| field | SFIInt32 | position2DNbBits | 16 |
| field | SFBool | drawOrderQuant | TRUE |
| field | SFVec3f | drawOrderMin | -∞ |
| field | SFVec3f | drawOrderMax | +∞ |
| field | SFIInt32 | drawOrderNbBits | 8 |
| field | SFBool | colorQuant | TRUE |
| field | SFFloat | colorMin | 0.0 |
| field | SFFloat | colorMax | 1.0 |
| field | SFIInt32 | colorNbBits | 8 |
| field | SFBool | textureCoordinateQuant | TRUE |
| field | SFFloat | textureCoordinateMin | 0.0 |
| field | SFFloat | textureCoordinateMax | 1.0 |
| field | SFIInt32 | textureCoordinateNbBits | 16 |
| field | SFBool | angleQuant | TRUE |
| field | SFFloat | angleMin | 0.0 |
| field | SFFloat | angleMax | 2π |
| field | SFIInt32 | angleNbBits | 16 |
| field | SFBool | scaleQuant | FALSE |
| field | SFFloat | scaleMin | 0.0 |
| field | SFFloat | scaleMax | +∞ |
| field | SFIInt32 | scaleNbBits | 8 |
| field | SFBool | keyQuant | TRUE |
| field | SFFloat | keyMin | 0.0 |
| field | SFFloat | keyMax | 1.0 |
| field | SFIInt32 | keyNbBits | 8 |
| field | SFBool | normalQuant | TRUE |
| field | SFIInt32 | normalNbBits | 8 |
| field | SFBool | sizeQuant | FALSE |
| field | SFFloat | sizeMin | 0.0 |
| field | SFFloat | sizeMax | +∞ |
| field | SFIInt32 | sizeNbBits | 8 |
| field | SFBool | useEfficientCoding | FALSE |

}

NOTE — For the binary encoding of this node see Annex [H.1.76](#).

9.4.2.89.2 Functionality and semantics

The **QuantizationParameter** node describes the quantization values to be applied on single fields of numerical types. For each of identified categories of fields, a minimal and maximal value is given as well as a number of bits to represent the given class of fields. Additionally, it is possible to set the **isLocal** field to apply the quantization only to the node following the **QuantizationParameter** node. The use of a node structure for declaring the quantization parameters allows the application of the DEF and USE mechanisms that enable reuse of the **QuantizationParameter** node. Also, it enables the parsing of this node in the same manner as any other scene information.

The **QuantizationParameter** node may only appear as a child of a grouping node. When a **QuantizationParameter** node appears in the scene graph, the quantization is set to TRUE, and will apply to subsequent nodes as follows:

If the **isLocal** boolean is set to FALSE, the quantization applies to all siblings following the **QuantizationParameter** node, and thus to all their children as well.

If the **isLocal** boolean is set to TRUE, the quantization only applies to the following sibling node in the children list of the parent node. If no sibling is following the **QuantizationParameter** node declaration, the node has no effect.

In all cases, the quantization is applied only in the scope of a single BIFS command. That is, if a command in the same access unit, or in another access unit inserts a node in a context in which the quantization was active, no quantization will be applied, except if a new **QuantizationParameter** node is defined in this new command.

The information contained in the **QuantizationParameter** node fields applies within the context of the node scope as follows. For each category of fields, a boolean sets the quantization on or off, the minimal and maximal values are set, as well as the number of bits for the quantization. This information, combined with the node coding table, enables the relevant information to quantize the fields to be obtained. The quantization parameters are applied as explained in 9.3.3.

If the **useEfficientCoding** boolean is set to FALSE, the encoding of floats shall be performed using 32 bits, according to IEEE Std 754-1985.

If the **useEfficientCoding** boolean is set to TRUE, the encoding of floats shall use the syntax described in 9.3.7.12. The scope of the use of the efficient coding is the same as that of the **QuantizationParameter** node. This means that the values of the fields of the current **QuantizationParameter** node are not sent in the efficient coding mode unless the context is within the scope of a previously sent **QuantizationParameter** whose **useEfficientCoding** bit was set to true.

9.4.2.90 Rectangle

9.4.2.90.1 Node interface

```
Rectangle {
    exposedField    SFVec2f      size           2, 2
}
```

NOTE — For the binary encoding of this node see Annex [H.1.77](#).

9.4.2.90.2 Functionality and semantics

This node specifies a rectangle centered at (0,0) in the local coordinate system. The **size** field specifies the horizontal and vertical size of the rendered rectangle.

9.4.2.91 ScalarInterpolator

9.4.2.91.1 Node interface

```
ScalarInterpolator {
    eventIn       SFFloat     set_fraction
    exposedField  MFFloat    key             []
}
```

```

exposedField    MFFloat      keyValue
eventOut        SFFloat       value_changed
}

[]
```

NOTE — For the binary encoding of this node see Annex [H.1.78](#).

9.4.2.91.2 Functionality and semantics

The semantics of the **ScalarInterpolator** node are specified in ISO/IEC 14772-1:1998, subclause 6.39.

9.4.2.92 Script

9.4.2.92.1 Node interface

```

Script {
  exposedField    MFString      url
  field           SFBool        directOutput
  field           SFBool        mustEvaluate
  Any number of the following may then follow:
  eventIn         eventType     eventName
  field           fieldType     fieldName
  eventOut        eventType     eventName
}

[]
```

NOTE — For the binary encoding of this node see Annex [H.1.79](#).

9.4.2.92.2 Functionality and semantics

The **Script** node is used to describe behaviour in a programmatic way in a scene. Script nodes typically

- signify a change or user action
- receive events from other nodes
- contain a program module that performs some computation
- effect change somewhere else in the scene by sending events

Each **Script** node has associated programming language code, referenced by the **url** field, that is executed to carry out the **Script** node's function. That code is referred to as the "script" in the rest of this description.

9.4.2.92.2.1 Detailed Semantics

The semantics of this node are as defined in ISO/IEC 14772-1:1998, subclause 6.40, with the following exception. The interface functions `CreateVRMLFromString()` and `CreateVRMLFromURL()` are not supported. The terminal shall support JavaScript.

EXAMPLE — The following scene contains two spheres that exchange colors when they are clicked with the mouse. The script is used to hold the current color state (in the variable `num`). The script variables `color1` and `color2` are used to hold the colors that are flipped back and forth between the two spheres. The script variable `color` is used to hold the last color state of the first sphere, and this color is routed to the second sphere. The first sphere color is set directly in the script.

```

Group {
  children [
    Viewpoint {
      fieldOfView 0.785398
    }
    DirectionalLight {
      color 1 1 1
    }
    Shape {
      geometry Sphere { radius 0.5}      # first sphere...
      appearance Appearance {
        material DEF COLOR Material {diffuseColor 1 0 0}
```

```

        }
    }
    Transform {
        translation -2 0 0
        children [
            Shape {
                geometry Sphere { radius 1.0} #second sphere...
                appearance Appearance {
                    material DEF COLOR2 Material {diffuseColor 1 1 1}
                }
            }
            DEF TS TouchSensor{} #clicking on the 2nd sphere will activate the script
        ]
    }
    DEF SC Script {
        eventIn SFBool touch
        field SFNode node USE COLOR
        field SFCOLOR color1 0 1 0 # constant color for sphere
        field SFCOLOR color2 0 0 1 # same as above
        field SFFloat num 1 # holds the current color state
        eventOut SFCOLOR color # holds the last color in COLOR
        url "javascript:
            function touch (value, tp) {
                color = node.diffuseColor;
                if (num==1) {
                    node.diffuseColor = color1;
                    num = 2;
                } else {
                    node.diffuseColor = color2;
                    num = 1;
                }
            }
        "
    }
}
ROUTE TS.isActive TO SC.touch      # activates the script when sensor is touched
ROUTE SC.color TO COLOR2.diffuseColor # routes the last color of COLOR to COLOR2

```

9.4.2.93 Shape

9.4.2.93.1 Node interface

| | | | |
|---------------------|-------------------|--|------|
| Shape { | | | |
| exposedField SFNode | appearance | | NULL |
| exposedField SFNode | geometry | | NULL |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.80](#).

9.4.2.93.2 Functionality and semantics

The semantics of the **Shape** node are specified in ISO/IEC 14772-1:1998, subclause 6.41.

9.4.2.94 Sound

9.4.2.94.1 Node interface

| | | | |
|----------------------|------------------|--|---------|
| Sound { | | | |
| exposedField SFVec3f | direction | | 0, 0, 1 |
| exposedField SFFloat | intensity | | 1.0 |
| exposedField SFVec3f | location | | 0, 0, 0 |
| exposedField SFFloat | maxBack | | 10.0 |
| exposedField SFFloat | maxFront | | 10.0 |
| exposedField SFFloat | minBack | | 1.0 |
| exposedField SFFloat | minFront | | 1.0 |
| exposedField SFFloat | priority | | 0.0 |

| | | | |
|-----------------------|------------------|------------------------------------|--------------|
| exposedField field | SFNode SFBool | source spatialize | NULL TRUE |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.81](#).

9.4.2.94.2 Functionality and semantics

The **Sound** node is used to attach sound to a scene, thereby giving it spatial qualities and relating it to the visual content of the scene.

The **Sound** node relates an audio BIFS sub-graph to the rest of an audio-visual scene. By using this node, sound may be attached to a group, and spatialized or moved around as appropriate for the spatial transforms above the node. By using the functionality of the audio BIFS nodes, sounds in an audio scene described using ISO/IEC 14496-1 may be filtered and mixed before being spatially composited into the scene.

The semantics of this node are as defined in ISO/IEC 14472-1:1997, subclause 6.42, with the following exceptions and additions.

The **source** field allows the connection of an audio sub-graph containing the sound.

The **spatialize** field determines whether the **Sound** shall be spatialized. If this flag is set, the sound shall be presented spatially according to the local coordinate system and current **listeningPoint**, so that it apparently comes from a source located at the **location** point, facing in the direction given by **direction**. The exact manner of spatialization is implementation-dependant, but implementors are encouraged to provide the maximum sophistication possible depending on terminal resources.

If there are multiple channels of sound output from the child sound, they may or may not be spatialized, according to the **phaseGroup** properties of the child, as follows. Any individual channels, that is, channels not phase-related to other channels, are summed linearly and then spatialized. Any phase-grouped channels are not spatialized, but passed through this node unchanged. The sound presented in the scene is thus a single spatialized sound, represented by the sum of the individual channels, plus an “ambient” sound represented by mapping all the remaining channels into the presentation system as described in 9.2.2.13.2.2.

If the **spatialize** field is not set, the audio channels from the child are passed through unchanged, and the sound presented in the scene due to this node is an “ambient” sound represented by mapping all the audio channels output by the child into the presentation system as described in 9.2.2.13.2.2.

As with the visual objects in the scene, the **Sound** node may be included as a child or descendant of any of the grouping or transform nodes. For each of these nodes, the sound semantics are as follows.

Affine transformations presented in the grouping and transform nodes affect the apparent spatialization position of spatialized sound. They have no effect on “ambient” sounds.

If a particular grouping or transform node has multiple **Sound** nodes as descendants, then they are combined for presentation as follows. Each of the **Sound** nodes may be producing a spatialized sound, a multichannel ambient sound, or both. For all of the spatialized sounds in descendant nodes, the sounds are linearly combined through simple summation from presentation. For multichannel ambient sounds, the sounds are linearly combined channel-by-channel for presentation.

EXAMPLE — **Sound** node S1 generates a spatialized sound s1 and five channels of multichannel ambient sound a1[1-5]. **Sound** node S2 generates a spatialized sound s2 and two channels of multichannel ambient sound a2[1-2]. S1 and S2 are grouped under a single **Group** node. The resulting sound is the superposition of the spatialized sound s1, the spatialized sound s2, and the five-channel ambient multichannel sound represented by a3[1-5], where

$$a3[1] = a1[1] + a2[1]$$

$$a3[2] = a1[2] + a2[2]$$

$$a3[3] = a1[3]$$

$$a3[4] = a1[4]$$

$$a3[5] = a1[5]$$

9.4.2.95 Sound2D

9.4.2.95.1 Node interface

| | | | |
|------------------|---------|-------------------|------|
| Sound2D { | | | |
| exposedField | SFFloat | intensity | 1.0 |
| exposedField | SFVec2f | location | 0,0 |
| exposedField | SFNode | source | NULL |
| field | SFBool | spatialize | TRUE |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.82](#).

9.4.2.95.2 Functionality and semantics

The **Sound2D** node relates an audio BIFS sub-graph to the other parts of a 2D audio-visual scene. It shall not be used in 3D contexts (see 9.2.2.1). By using this node, sound may be attached to a group of visual nodes. By using the functionality of the audio BIFS nodes, sounds in an audio scene may be filtered and mixed before being spatially composed into the scene.

The **intensity** field adjusts the loudness of the sound. Its value ranges from 0.0 to 1.0, and this value specifies a factor that is used during the playback of the sound.

The **location** field specifies the location of the sound in the 2D scene.

The **source** field connects the audio source to the **Sound2D** node.

The **spatialize** field specifies whether the sound shall be spatialized on the 2D screen. If this flag is set, the sound shall be spatialized with the maximum sophistication possible. The 2D sound is spatialized assuming a distance of one meter between the user and a 2D scene of size 2m x 1.5m, giving the minimum and maximum azimuth angles of -45° and +45°, and the minimum and maximum elevation angles of -37° and +37°.

The same rules for multichannel audio spatialization apply to the **Sound2D** node as to the **Sound** (3D) node (see 9.4.2.94). Using the **phaseGroup** flag in the **AudioSource** node it is possible to determine whether the channels of the source sound contain important phase relations, and that spatialization at the terminal should not be performed.

As with the visual objects in the scene (and for the **Sound** node), the **Sound2D** node may be included as a child or descendant of any of the grouping or transform nodes. For each of these nodes, the sound semantics are as follows.

Affine transformations presented in the grouping and transform nodes affect the apparent spatialization position of spatialized sound.

If a transform node has multiple **Sound2D** nodes as descendants, then they are combined for presentation as described in 9.4.2.94. If **Sound** and **Sound2D** nodes are both used in a scene, all shall be treated the same way according to these semantics.

9.4.2.96 Sphere

9.4.2.96.1 Node interface

| | | | |
|-----------------|---------|---------------|-----|
| Sphere { | | | |
| field | SFFloat | Radius | 1.0 |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.83](#).

9.4.2.96.2 Functionality and semantics

The semantics of the **Sphere** node are specified in ISO/IEC 14772-1:1998, subclause 6.43.

9.4.2.97 SphereSensor

9.4.2.97.1 Node interface

```
SphereSensor {
    exposedField SFBool      autoOffset          TRUE
    exposedField SFBool      enabled            TRUE
    exposedField SFRotation   offset              0 1 0 0
    eventOut     SFBool      isActive
    eventOut     SFRotation   rotation_changed
    eventOut     SFVec3f     trackPoint_changed
}
}
```

NOTE — For the binary encoding of this node see Annex [H.1.84](#).

9.4.2.97.2 Functionality and semantics

The semantics of the **SphereSensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.44.

9.4.2.98 SpotLight

9.4.2.98.1 Node interface

```
SpotLight {
    exposedField SFFloat     ambientIntensity    0.0
    exposedField SFVec3f     attenuation        1, 0, 0
    exposedField SFFloat     beamWidth         1.5708
    exposedField SFColor     color              1, 1, 1
    exposedField SFFloat     cutOffAngle       0.785398
    exposedField SFVec3f     direction        0, 0, -1
    exposedField SFFloat     intensity         1.0
    exposedField SFVec3f     location          0, 0, 0
    exposedField SFBool      on                TRUE
    exposedField SFFloat     radius           100.0
}
}
```

NOTE — For the binary encoding of this node see Annex [H.1.85](#).

9.4.2.98.2 Functionality and semantics

The semantics of the **SpotLight** node are specified in ISO/IEC 14772-1:1998, subclause 6.45.

9.4.2.99 Switch

9.4.2.99.1 Node interface

```
Switch {
    exposedField MFNode      choice             []
    exposedField SFInt32     whichChoice       -1
}
}
```

NOTE — For the binary encoding of this node see Annex [H.1.86](#).

9.4.2.99.2 Functionality and semantics

The semantics of the **Switch** node are specified in ISO/IEC 14772-1:1998, subclause 6.46, with the following restrictions.

If some of the child sub-graphs contain audio content (i.e., the subgraphs contain **Sound** nodes), the child sounds are switched on and off according to the value of the **whichChoice** field. That is, only sound that corresponds to **Sound** nodes in the **whichChoice**'th subgraph of this node are played. The others are muted.

9.4.2.100 TermCap

9.4.2.100.1 Node interface

```
TermCap {
    eventIn      SFTime     evaluate
    field        SFInt32   capability
    eventOut     SFInt32   value
}
```

NOTE — For the binary encoding of this node see Annex [H.1.87](#).

9.4.2.100.2 Functionality and semantics

The **TermCap** node is used to query the resources of the terminal. By ROUTEing the result to a **Switch** node, simple adaptive content may be authored using BIFS.

When this node is instantiated, the value of the **capability** field shall be examined by the system and the **value** eventOut generated to indicate the associated system capability. The **value** eventOut is updated and generated whenever an **evaluate** eventIn is received.

The **capability** field specifies a terminal resource to query. The semantics of the **value** field vary depending on the value of this field. The capabilities which may be queried are:

Table 39 - Semantics of value, dependent on capability

| capability | Semantics of value |
|-------------------|-----------------------------|
| 0 | frame rate |
| 1 | color depth |
| 2 | screen size |
| 3 | graphics hardware |
| 32 | audio output format |
| 33 | maximum audio sampling rate |
| 34 | spatial audio capability |
| 64 | CPU load |
| 65 | memory load |

The exact semantics differ depending on the value of the **capability** field, as follows.

capability: 0 (frame rate)

For this value of **capability**, the current rendering frame rate is measured. The exact method of measurement not specified.

Table 40 - Semantics of value for capability=0

| value | Semantics |
|--------------|----------------------------|
| 0 | unknown or can't determine |
| 1 | less than 5 fps |
| 2 | 5-10 fps |
| 3 | 10-20 fps |
| 4 | 20-40 fps |
| 5 | more than 40 fps |

For the breakpoint between overlapping values between each range (i.e. 5, 10, 20, and 40), the higher value of **value** shall be used (ie, 2, 3, 4, and 5 respectively). This applies to each of the subsequent **capability-value** tables as well.

capability: 1 (color depth)

For this value of **capability**, the color depth of the rendering terminal is measured. At the time this node is instantiated, the **value** field is set to indicate the color depth as follows:

Table 41 - Semantics of value for capability=1

| value | Semantics |
|-------|-------------------------------|
| 0 | unknown or can't determine |
| 1 | 1 bit/pixel |
| 2 | grayscale |
| 3 | color, 3-12 bit/pixel |
| 4 | color, 12-24 bit/pixel |
| 5 | color, more than 24 bit/pixel |

capability: 2 (screen size)

For this value of **capability**, the window size (in horizontal lines) of the output window of the rendering terminal is measured:

Table 42 - Semantics of value for capability=2

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | less than 200 lines |
| 2 | 200-400 lines |
| 3 | 400-800 lines |
| 4 | 800-1600 lines |
| 5 | 1600 or more lines |

capability: 3 (graphics hardware)

For this value of **capability**, the available of graphics acceleration hardware of the rendering terminal is measured. At the time this node is instantiated, the **value** field is set to indicate the available graphics hardware:

Table 43 - Semantics of value for capability=3

| value | Semantics |
|-------|---|
| 0 | unknown or can't determine |
| 1 | no acceleration |
| 2 | matrix multiplication |
| 3 | matrix multiplication + texture mapping (less than 1M memory) |
| 4 | matrix multiplication + texture mapping (less than 4M memory) |
| 5 | matrix multiplication + texture mapping (more than 4M memory) |

capability: 32 (audio output format)

For this value of **capability**, the audio output format (speaker configuration) of the rendering terminal is measured. At the time this node is instantiated, the **value** field is set to indicate the audio output format.

Table 44 - Semantics of value for capability=32

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | mono |
| 2 | stereo speakers |
| 3 | stereo headphones |
| 4 | five-channel surround |
| 5 | more than five speakers |

capability: 33 (maximum audio sampling rate)

For this value of **capability**, the maximum audio output sampling rate of the rendering terminal is measured. At the time this node is instantiated, the **value** field is set to indicate the maximum audio output sampling rate.

Table 45 - Semantics of value for capability=33

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | less than 16000 Hz |
| 2 | 16000-32000 Hz |
| 3 | 32000-44100 Hz |
| 4 | 44100-48000 Hz |
| 5 | 48000 Hz or more |

capability: 34 (spatial audio capability)

For this value of **capability**, the spatial audio capability of the rendering terminal is measured. At the time this node is instantiated, the **value** field is set to indicate the spatial audio capability.

Table 46 - Semantics of value for capability=34

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | no spatial audio |
| 2 | panning only |
| 3 | azimuth only |
| 4 | full 3-D spatial audio |

capability: 64 (CPU load)

For this value of **capability**, the CPU load of the rendering terminal is measured. The exact method of measurement is not specified. The value of the **value** eventOut indicates the available CPU resources as a percentage of the maximum available; that is, if all of the CPU cycles are being consumed, and no extra calculation can be performed without compromising real-time performance, the indicated value is 100%; if twice as much calculation as currently being done can be so performed, the indicated value is 50%.

Table 47 - Semantics of value for capability=64

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | less than 20% loaded |
| 2 | 20-40% loaded |
| 3 | 40-60% loaded |
| 4 | 60-80% loaded |
| 5 | 80-100% loaded |

capability: 65 (RAM available)

For this value of **capability**, the available memory of the rendering terminal is measured. The exact method of measurement is not specified.

Table 48 - Semantics of value for capability=65

| value | Semantics |
|-------|----------------------------|
| 0 | unknown or can't determine |
| 1 | less than 100 KB free |
| 2 | 100 KB – 500 KB free |
| 3 | 500 KB – 2 MB free |
| 4 | 2 MB – 8 MB free |
| 5 | 8 MB – 32 MB free |
| 6 | 32 MB – 200 MB free |
| 7 | more than 200 MB free |

9.4.2.101 Text

9.4.2.101.1 Node interface

```
Text {
    exposedField MFString      string          []
    exposedField MFFloat       length         []
    exposedField SFNode        fontStyle      NULL
    exposedField SFFloat       maxExtent     0.0
}
```

NOTE — For the binary encoding of this node see Annex [H.1.88](#).

9.4.2.101.2 Functionality and semantics

The semantics of the **Text** node are specified in ISO/IEC 14772-1:1998, subclause 6.47.

9.4.2.102 TextureCoordinate

9.4.2.102.1 Node interface

```
TextureCoordinate {
    exposedField MFVec2f      point          []
}
```

NOTE — For the binary encoding of this node see Annex [H.1.89](#).

9.4.2.102.2 Functionality and semantics

The semantics of the **TextureCoordinate** node are specified in ISO/IEC 14772-1:1998, subclause 6.48.

9.4.2.103 TextureTransform

9.4.2.103.1 Node interface

```
TextureTransform {
    exposedField SFVec2f   center          0, 0
    exposedField SFFloat  rotation        0.0
    exposedField SFVec2f   scale           1, 1
    exposedField SFVec2f   translation     0, 0
}
```

NOTE — For the binary encoding of this node see Annex [H.1.90](#).

9.4.2.103.2 Functionality and semantics

The semantics of the **TextureTransform** node are specified in ISO/IEC 14772-1:1998, subclause 6.49.

9.4.2.104 TimeSensor

9.4.2.104.1 Node interface

```
TimeSensor {
    exposedField SFTime    cycleInterval  1
    exposedField SFBool   enabled        TRUE
    exposedField SFBool   loop          FALSE
    exposedField SFTime    startTime      0
    exposedField SFTime    stopTime       0
    eventOut      SFTime    cycleTime
    eventOut      SFFloat   fraction_changed
    eventOut      SFBool    isActive
    eventOut      SFTime    time
}
```

NOTE — For the binary encoding of this node see Annex [H.1.91](#).

9.4.2.104.2 Functionality and semantics

The semantics of the **TimeSensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.50.

9.4.2.105 TouchSensor

9.4.2.105.1 Node interface

```
TouchSensor {
    exposedField SFBool   enabled        TRUE
    eventOut      SFVec3f  hitNormal_changed
    eventOut      SFVec3f  hitPoint_changed
    eventOut      SFVec2f  hitTexCoord_changed
    eventOut      SFBool    isActive
    eventOut      SFBool    isOver
    eventOut      SFTime   touchTime
}
```

NOTE — For the binary encoding of this node see Annex [H.1.92](#).

9.4.2.105.2 Functionality and semantics

The semantics of the **TouchSensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.51.

9.4.2.106 Transform

9.4.2.106.1 Node interface

| | | |
|--------------------|------------|------------------------------------|
| Transform { | | |
| eventIn | MFNode | addChildren |
| eventIn | MFNode | removeChildren |
| exposedField | SFVec3f | center 0, 0, 0 |
| exposedField | MFNode | children [] |
| exposedField | SFRotation | rotation 0, 0, 1, 0 |
| exposedField | SFVec3f | scale 1, 1, 1 |
| exposedField | SFRotation | scaleOrientation 0, 0, 1, 0 |
| exposedField | SFVec3f | translation 0, 0, 0 |
| } | | |

NOTE — For the binary encoding of this node see Annex [H.1.93](#).

9.4.2.106.2 Functionality and semantics

The semantics of the **Transform** node are specified in ISO/IEC 14772-1:1998, subclause 6.52. ISO/IEC 14496-1 does not support the bounding box parameters (**bboxCenter** and **bboxSize**).

If some of the child subgraphs contain audio content (i.e., the subgraphs contain **Sound** nodes), the child sounds are transformed and mixed as follows.

If each of the child sounds is a spatially presented sound, the **Transform** node applies to the local coordinate system of the **Sound** nodes to alter the apparent spatial location and direction. If the children are not spatially presented but have equal numbers of channels, the **Transform** node has no effect on the childrens' sounds. After any such transformation, the combination of sounds is performed as described in 9.4.2.94.

If the children are not spatially presented but have equal numbers of channels, the **Transform** node has no effect on the childrens' sounds. The child sounds are summed equally to produce the audio output at this node.

If some children are spatially presented and some not, or all children do not have equal numbers of channels, the semantics are not defined.

9.4.2.107 Transform2D

9.4.2.107.1 Node interface

| | | |
|----------------------|---------|-----------------------------|
| Transform2D { | | |
| eventIn | MFNode | addChildren |
| eventIn | MFNode | removeChildren |
| exposedField | SFVec2f | center 0, 0 |
| exposedField | MFNode | children [] |
| exposedField | SFFloat | rotationAngle 0.0 |
| exposedField | SFVec2f | scale 1, 1 |
| exposedField | SFFloat | scaleOrientation 0.0 |
| exposedField | SFVec2f | translation 0, 0 |
| } | | |

NOTE — For the binary encoding of this node see Annex [H.1.94](#).

9.4.2.107.2 Functionality and semantics

The **Transform2D** node allows the translation, rotation and scaling of its 2D children objects.

The **rotation** field specifies a rotation of the child objects, in radians, which occurs about the point specified by **center**.

The **scale** field specifies a 2D scaling of the child objects. The scaling operation takes place following a rotation of the 2D coordinate system that is specified, in radians, by the **scaleOrientation** field. The rotation of the coordinate system is notional and purely for the purpose of applying the scaling and is undone before any further actions are performed. No permanent rotation of the co-ordinate system is implied.

The **translation** field specifies a 2D vector which translates the child objects.

The scaling, rotation and translation are applied in the following order: scale, rotate, translate.

The **children** field contains a list of zero or more children nodes which are grouped by the **Transform2D** node.

The **addChildren** and **removeChildren** events are used to add or remove child nodes from the **children** field of the node. Children are added to the end of the list of children and special note should be taken of the implications of this for implicit drawing orders.

If some of the child subgraphs contain audio content (i.e., the subgraphs contain **Sound** nodes), the child sounds are transformed and mixed as follows.

If each of the child sounds is a spatially presented sound, the **Transform** node applies to the local coordinate system of the **Sound** nodes to alter the apparent spatial location and direction. If the children are not spatially presented but have equal numbers of channels, the **Transform** node has no effect on the children's sounds. After any such transformation, the combination of sounds is performed as described in 9.4.2.94.

If the children are not spatially presented but have equal numbers of channels, the **Transform** node has no effect on the children's sounds. The child sounds are summed equally to produce the audio output at this node.

If some children are spatially presented and some not, or all children do not have equal numbers of channels, the semantics are not defined.

9.4.2.108 Valuator

9.4.2.108.1 Node interface

Valuator {

| | | |
|----------|------------|---------------------|
| eventIn | SFBool | inSFBool |
| eventIn | SFColor | inSFColor |
| eventIn | MFCColor | inMFColor |
| eventIn | SFFloat | inSFFloat |
| eventIn | MFFloat | inMFFloat |
| eventIn | SFInt32 | inSFInt32 |
| eventIn | MFInt32 | inMFInt32 |
| eventIn | SFRotation | inSFRotation |
| eventIn | MFRotation | inMFRotation |
| eventIn | SFString | inSFString |
| eventIn | MFString | inMFString |
| eventIn | SFTime | inSFTime |
| eventIn | SFVec2f | inSFVec2f |
| eventIn | MFVec2f | inMFVec2f |
| eventIn | SFVec3f | inSFVec3f |
| eventIn | MFVec3f | inMFVec3f |
| eventOut | SFBool | outSFBool |
| eventOut | SFColor | outSFColor |

| | | | |
|--------------|------------|----------------------|-------|
| eventOut | MFColor | outMFColor | |
| eventOut | SFFloat | outSFFloat | |
| eventOut | MFFloat | outMFFloat | |
| eventOut | SFInt32 | outSFInt32 | |
| eventOut | MFInt32 | outMFInt32 | |
| eventOut | SFRotation | outSFRotation | |
| eventOut | MFRotation | outMFRotation | |
| eventOut | SFString | outSFString | |
| eventOut | MFString | outMFString | |
| eventOut | SFTime | outSFTime | |
| eventOut | SFVec2f | outSFVec2f | |
| eventOut | MFVec2f | outMFVec2f | |
| eventOut | SFVec3f | outSFVec3f | |
| eventOut | MFVec3f | outMFVec3f | |
| exposedField | SFFloat | factor1 | 1.0 |
| exposedField | SFFloat | factor2 | 1.0 |
| exposedField | SFFloat | factor3 | 1.0 |
| exposedField | SFFloat | factor4 | 1.0 |
| exposedField | SFFloat | offset1 | 0.0 |
| exposedField | SFFloat | offset2 | 0.0 |
| exposedField | SFFloat | offset3 | 0.0 |
| exposedField | SFFloat | offset4 | 0.0 |
| exposedField | SFBool | sum | FALSE |

{}

NOTE — For the binary encoding of this node see Annex [H.1.95](#).

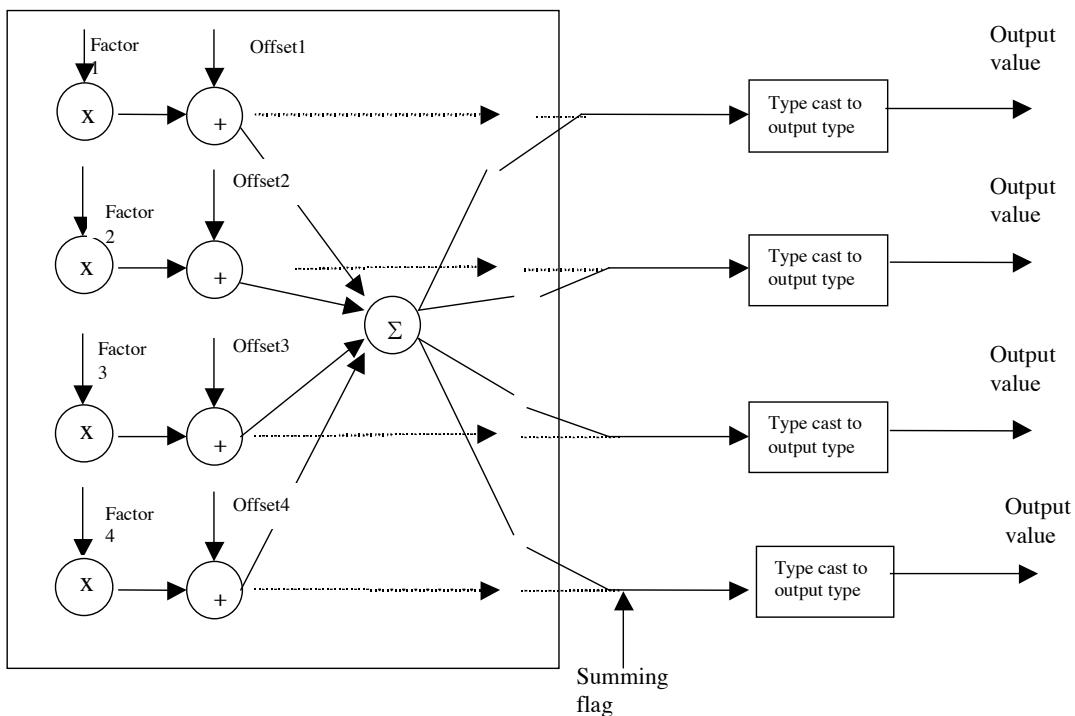
9.4.2.108.2 Functionality and semantics

A **Valuator** node can receive an event of any type, and on reception of such an event, will trigger eventOuts of many different types. Upon reception of an event on any of its eventIns, on each eventOut connected to a ROUTE an event will be generated. The value of this event is governed by the equation below. This node serves as a simple type casting method.

Each output value is dependent on the input value with the following relationship:

$$\text{output value} = \text{factor} * x + \text{offset}$$

In the above equation, factor is one of the exposedField values and offset is one of the eventOut values specified in the node interface. All values specified in the above equation are floating point values.

**Figure 27 - Valuator functionality**

Referring to the above figure, there are input paths each catering to an input value. Depending on the data type, there may be one to four input values. For example the SFRotation will require four input paths but the SFInt32 will only require the first input path. Each input path will operate identically.

Table 49 - Simple typecasting conversion from other data types to float.

| From | Conversion to float |
|-------------|----------------------------------|
| integer | Direct conversion. (1 to 1.0) |
| Boolean | true – 1.0 false – 0.0 |
| double | Truncate to 32-bit precision |

Table 50 - Simple typecasting conversion from float to other data types.

| To | Conversion from float |
|-----------|--|
| integer | Truncate floating point. eg (1.11 to 1) |
| Boolean | 0.0 to False Any other values to true |
| double | Direct conversion |

Each input value is converted to a floating-point value using a simple typecasting rule as illustrated in Table 50. After conversion, the values are multiplied by the corresponding factor value and added to the corresponding offset value. Depending on whether the summer is enabled, either the summed value or the individual values are presented at the output.

Depending on the output data type required, the corresponding number of output values are retrieved and converted to the output types according to Table 49.

In the event that the input value is of a multi-valued type and the output is of a single value type, the first value of the multi-valued input is used.

EXAMPLE — The **Valuator** node can be seen as an event type adapter. One use of this node is the modification of the SFInt32 **whichChoice** field of a **Switch** node by an event. There is no interpolator or sensor node with a SFInt32 eventOut. Thus, if a two-state button is described with a **Switch** containing the description of each state in choices 0 and 1. The triggering event of any type can be routed to a **Valuator** node whose SFInt32 field is routed to the **whichChoice** field of the **Switch**.

9.4.2.109 Viewpoint

9.4.2.109.1 Node interface

| | | | |
|--------------------|------------|--------------------|------------|
| Viewpoint { | | | |
| eventIn | SFBool | set_bind | |
| exposedField | SFFloat | fieldOfView | 0.785398 |
| exposedField | SFBool | jump | TRUE |
| exposedField | SFRotation | orientation | 0, 0, 1, 0 |
| exposedField | SFVec3f | position | 0, 0, 10 |
| field | SFString | description | "" |
| eventOut | SFTime | bindTime | |
| eventOut | SFBool | isBound | |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.96](#).

9.4.2.109.2 Functionality and semantics

The semantics of the **Viewpoint** node are specified in ISO/IEC 14772-1:1998, subclause 6.53.

9.4.2.110 Viseme

9.4.2.110.1 Node interface

| | | | |
|-----------------|---------|-----------------------|-------|
| Viseme { | | | |
| field | SFInt32 | viseme_select1 | 0 |
| field | SFInt32 | viseme_select2 | 0 |
| field | SFInt32 | viseme_blend | 0 |
| field | SFBool | viseme_def | FALSE |
| } | | | |

NOTE — For the binary encoding of this node see Annex [H.1.97](#).

9.4.2.110.2 Functionality and semantics

The **Viseme** node defines a blend of two visemes from a standard set of 14 visemes as defined in ISO/IEC 14496-2, Annex C, Table C-5.

The **viseme_select1** field specifies viseme 1.

The **viseme_select2** field specifies viseme 2.

The **viseme_blend** field specifies the blend of the two visemes.

If **viseme_def** is TRUE, the current FAPs shall be used to define a viseme and store it.

9.4.2.111 VisibilitySensor

9.4.2.111.1 Node interface

VisibilitySensor {

| | | | |
|--------------|---------|------------------|-------|
| exposedField | SFVec3f | center | 0 0 0 |
| exposedField | SFBool | enabled | TRUE |
| exposedField | SFVec3f | size | 0 0 0 |
| eventOut | SFTime | enterTime | |
| eventOut | SFTime | exitTime | |
| eventOut | SFBool | isActive | |

}

NOTE — For the binary encoding of this node see Annex [H.1.98](#).

9.4.2.111.2 Functionality and semantics

The semantics of the **VisibilitySensor** node are specified in ISO/IEC 14772-1:1998, subclause 6.54.

9.4.2.112 WorldInfo

9.4.2.112.1 Node interface

WorldInfo {

| | | | |
|-------|----------|--------------|----|
| field | MFString | info | [] |
| field | SFString | title | "" |

}

NOTE — For the binary encoding of this node see Annex [H.1.99](#).

9.4.2.112.2 Functionality and semantics

The semantics of the **WorldInfo** node are specified in ISO/IEC 14772-1:1998, subclause 6.55.

10 Synchronization of Elementary Streams

10.1 Introduction

This subclause defines the tools to maintain temporal synchronisation within and among elementary streams. The conceptual elements that are required for this purpose, namely time stamps and clock reference information, have already been introduced in clause 7. The syntax and semantics to convey these elements to a receiving terminal are embodied in the sync layer, specified in 10.2. This syntax is configurable to adapt to the needs of different types of elementary streams. The required configuration information is specified in 10.2.3.

On the sync layer, an elementary stream is mapped into a sequence of packets, called an SL-packetized stream (SPS). Packetization information has to be exchanged between the entity that generates an elementary stream and the sync layer. This relation may be described by a conceptual elementary stream interface (ESI) between both layers (see Annex L). The ESI is a concept to explain the information flow between layers, however, need not be accessible in an implementation.

SL-packetized streams are conveyed through a delivery mechanism that is outside the scope of ISO/IEC 14496-1. This delivery mechanism is only described in terms of the DMIF Application Interface (DAI) whose semantics are specified in ISO/IEC 14496-6. It specifies the information that needs to be exchanged between the sync layer and the delivery mechanism. The basic data transport feature that this delivery mechanism shall provide is the framing of the data packets generated by the sync layer. The DAI is a reference point that need not be accessible in an implementation. The required properties of the DAI are described in 10.3.

The items specified in this clause are depicted in Figure 28 below.

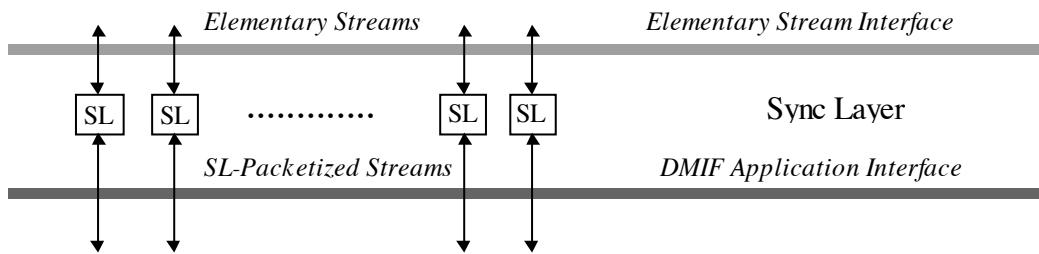


Figure 28 - The sync layer

10.2 Sync Layer

10.2.1 Overview

The sync layer (SL) specifies a syntax for the packetization of elementary streams into access units or parts thereof. Such a packet is called SL packet. The sequence of SL packets resulting from one elementary stream is called an SL-packetized stream (SPS). Access units are the only semantic entities at this layer that need to be preserved from end to end. Their content is opaque. Access units are used as the basic unit for synchronisation.

An SL packet consists of an SL packet header and an SL packet payload. The SL packet header provides means for continuity checking in case of data loss and carries the coded representation of the time stamps and associated information. The detailed semantics of the time stamps are specified in 7.3 that defines the timing aspects of the systems decoder model. The SL packet header is configurable as specified in 10.2.3. The SL packet header itself is specified in 10.2.4.

An SL packet does not contain an indication of its length. Therefore, SL packets must be framed by a suitable lower layer protocol using, e.g., the FlexMux tool specified in 12. Consequently, an SL-packetized stream is not a self-contained data stream that can be stored or decoded without such framing.

An SL-packetized stream does not provide identification of the ES_ID associated to the elementary stream (see 8.6.5) in the SL packet header. This association must be conveyed through a stream map table using the appropriate signalling means of the delivery mechanism.

10.2.2 SL Packet Specification

10.2.2.1 Syntax

```
class SL_Packet (SLConfigDescriptor SL) {
    aligned(8) SL_PacketHeader slPacketHeader(SL);
    aligned(8) SL_PacketPayload slPacketPayload;
}
```

10.2.2.2 Semantics

In order to properly parse an `SL_Packet`, it is required that the `SLConfigDescriptor` for the elementary stream to which the `SL_Packet` belongs is known, since the `SLConfigDescriptor` conveys the configuration of the syntax of the SL packet header.

`slPacketHeader` – an `SL_PacketHeader` element as specified in 10.2.4.

`slPacketPayload` – an `SL_PacketPayload` that contains an opaque payload.

10.2.3 SL Packet Header Configuration

10.2.3.1 Syntax

```
class SLConfigDescriptor extends BaseDescriptor : bit(8) tag=SLConfigDescrTag {
    bit(8) predefined;
    if (predefined==0) {
        bit(1) useAccessUnitStartFlag;
        bit(1) useAccessUnitEndFlag;
```

```

bit(1) useRandomAccessPointFlag;
bit(1) hasRandomAccessUnitsOnlyFlag;
bit(1) usePaddingFlag;
bit(1) useTimeStampsFlag;
bit(1) useIdleFlag;
bit(1) durationFlag;
bit(32) timeStampResolution;
bit(32) OCRResolution;
bit(8) timeStampLength; // must be ≤ 64
bit(8) OCRLength; // must be ≤ 64
bit(8) AU_Length; // must be ≤ 32
bit(8) instantBitrateLength;
bit(4) degradationPriorityLength;
bit(5) AU_seqNumLength; // must be ≤ 16
bit(5) packetSeqNumLength; // must be ≤ 16
bit(2) reserved=0b11;
}
if (durationFlag) {
    bit(32) timeScale;
    bit(16) accessUnitDuration;
    bit(16) compositionUnitDuration;
}
if (!useTimeStampsFlag) {
    bit(timeStampLength) startDecodingTimeStamp;
    bit(timeStampLength) startCompositionTimeStamp;
}
}

```

10.2.3.2 Semantics

The SL packet header may be configured according to the needs of each individual elementary stream. Parameters that can be selected include the presence, resolution and accuracy of time stamps and clock references. This flexibility allows, for example, a low bitrate elementary stream to incur very little overhead on SL packet headers.

For each elementary stream the configuration is conveyed in an **SLConfigDescriptor**, which is part of the associated **ES_Descriptor** within an object descriptor.

The configurable parameters in the SL packet header can be divided in two classes: those that apply to each SL packet (e.g. OCR, sequenceNumber) and those that are strictly related to access units (e.g. time stamps, accessUnitLength, instantBitrate, degradationPriority).

predefined – allows to default the values from a set of predefined parameter sets as detailed below.

NOTE – This table will be updated by amendments to ISO/IEC 14496 to include predefined configurations as required by future profiles.

Table 51 - Overview of predefined **SLConfigDescriptor values**

| Predefined field value | Description |
|-------------------------------|-------------------------------|
| 0x00 | Custom |
| 0x01 | null SL packet header |
| 0x02 | Reserved for use in MP4 files |
| 0x03 – 0xFF | Reserved for ISO use |

Table 52 – Detailed predefined SLConfigDescriptor values

| Predefined field value | 0x01 | 0x02 |
|-------------------------------|-------------|-------------|
| UseAccessUnitStartFlag | 0 | 0 |
| UseAccessUnitEndFlag | 0 | 0 |
| UseRandomAccessPointFlag | 0 | 0 |
| UsePaddingFlag | 0 | 0 |
| UseTimeStampsFlag | 0 | 1 |
| UseIdleFlag | 0 | 0 |
| DurationFlag | - | 0 |
| TimeStampResolution | 1000 | - |
| OCRResolution | - | - |
| TimeStampLength | 32 | 0 |
| OCRLength | - | 0 |
| AU_length | 0 | 0 |
| InstantBitrateLength | - | 0 |
| DegradationPriorityLength | 0 | 0 |
| AU_seqNumLength | 0 | 0 |
| PacketSeqNumLength | 0 | 0 |
| TimeScale | - | - |
| AccessUnitDuration | - | - |
| CompositionUnitDuration | - | - |
| StartDecodingTimeStamp | - | - |
| StartCompositionTimeStamp | - | - |

`useAccessUnitStartFlag` – indicates that the `accessUnitStartFlag` is present in each SL packet header of this elementary stream.

`useAccessUnitEndFlag` – indicates that the `accessUnitEndFlag` is present in each SL packet header of this elementary stream.

If neither `useAccessUnitStartFlag` nor `useAccessUnitEndFlag` are set this implies that each SL packet corresponds to a complete access unit.

`useRandomAccessPointFlag` – indicates that the `RandomAccessPointFlag` is present in each SL packet header of this elementary stream.

`hasRandomAccessUnitsOnlyFlag` – indicates that each SL packet corresponds to a random access point. In that case the `randomAccessPointFlag` need not be used.

`usePaddingFlag` – indicates that the `paddingFlag` is present in each SL packet header of this elementary stream.

`useTimeStampsFlag` – indicates that time stamps are used for synchronisation of this elementary stream. They are conveyed in the SL packet headers. Otherwise, the parameters `accessUnitRate`, `compositionUnitRate`, `startDecodingTimeStamp` and `startCompositionTimeStamp` conveyed in this SL packet header configuration shall be used for synchronisation.

NOTE – The use of start time stamps and durations (`useTimeStampsFlag=0`) may only be feasible under some conditions, including an error free environment. Random access is not easily possible.

`useIdleFlag` – indicates that `idleFlag` is used in this elementary stream.

`durationFlag` – indicates that the constant duration of access units and composition units for this elementary stream is subsequently signaled.

`timeStampResolution` – is the resolution of the time stamps in clock ticks per second.

OCRResolution – is the resolution of the object time base in cycles per second.

timeStampLength – is the length of the time stamp fields in SL packet headers. timeStampLength shall take values between zero and 64 bit.

OCRLength – is the length of the objectClockReference field in SL packet headers. A length of zero indicates that no objectClockReferences are present in this elementary stream. If OCRstreamFlag is set, OCRLength shall be zero. Else OCRLength shall take values between zero and 64 bit.

AU_Length – is the length of the accessUnitLength fields in SL packet headers for this elementary stream. AU_Length shall take values between zero and 32 bit.

instantBitrateLength – is the length of the instantBitrate field in SL packet headers for this elementary stream.

degradationPriorityLength – is the length of the degradationPriority field in SL packet headers for this elementary stream.

AU_seqNumLength – is the length of the AU_sequenceNumber field in SL packet headers for this elementary stream.

packetSeqNumLength – is the length of the packetSequenceNumber field in SL packet headers for this elementary stream.

timeScale – used to express the duration of access units and composition units. One second is evenly divided in timeScale parts.

accessUnitDuration – the duration of an access unit is accessUnitDuration * 1/timeScale seconds.

compositionUnitDuration – the duration of a composition unit is compositionUnitDuration * 1/timeScale seconds.

startDecodingTimeStamp – conveys the time at which the first access unit of this elementary stream shall be decoded. It is conveyed in the resolution specified by timeStampResolution.

startCompositionTimeStamp – conveys the time at which the composition unit corresponding to the first access unit of this elementary stream shall be decoded. It is conveyed in the resolution specified by timeStampResolution.

10.2.4 SL Packet Header Specification

10.2.4.1 Syntax

```
aligned(8) class SL_PacketHeader (SLConfigDescriptor SL) {
    if (SL.useAccessUnitStartFlag)
        bit(1) accessUnitStartFlag;
    if (SL.useAccessUnitEndFlag)
        bit(1) accessUnitEndFlag;
    if (SL.OCRLength>0)
        bit(1) OCRflag;
    if (SL.useIdleFlag)
        bit(1) idleFlag;
    if (SL.usePaddingFlag)
        bit(1) paddingFlag;
    if (paddingFlag)
        bit(3) paddingBits;

    if (!idleFlag && (!paddingFlag || paddingBits!=0)) {
        if (SL.packetSeqNumLength>0)
            bit(SL.packetSeqNumLength) packetSequenceNumber;
        if (SL.degradationPriorityLength>0)
```

```

    bit(1) DegPrioFlag;
    if (DegPrioFlag)
        bit(SL.degradationPriorityLength) degradationPriority;
    if (OCRflag)
        bit(SL.OCRLength) objectClockReference;

    if (accessUnitStartFlag) {
        if (SL.useRandomAccessPointFlag)
            bit(1) randomAccessPointFlag;
        if (SL.AU_seqNumLength >0)
            bit(SL.AU_seqNumLength) AU_sequenceNumber;
        if (SL.useTimeStampsFlag) {
            bit(1) decodingTimeStampFlag;
            bit(1) compositionTimeStampFlag;
        }
        if (SL.instantBitrateLength>0)
            bit(1) instantBitrateFlag;
        if (decodingTimeStampFlag)
            bit(SL.timeStampLength) decodingTimeStamp;
        if (compositionTimeStampFlag)
            bit(SL.timeStampLength) compositionTimeStamp;
        if (SL.AU_Length > 0)
            bit(SL.AU_Length) accessUnitLength;
        if (instantBitrateFlag)
            bit(SL.instantBitrateLength) instantBitrate;
    }
}
}

```

10.2.4.2 Semantics

accessUnitStartFlag – when set to one indicates that the first byte of the payload of this SL packet is the start of an access unit. If this syntax element is omitted from the SL packet header configuration its default value is known from the previous SL packet with the following rule:

$$\text{accessUnitStartFlag} = (\text{previous-SL packet has accessUnitEndFlag==1}) ? 1 : 0.$$

accessUnitEndFlag – when set to one indicates that the last byte of the SL packet payload is the last byte of the current access unit. If this syntax element is omitted from the SL packet header configuration its default value is only known after reception of the subsequent SL packet with the following rule:

$$\text{accessUnitEndFlag} = (\text{subsequent-SL packet has accessUnitStartFlag==1}) ? 1 : 0.$$

If neither **AccessUnitStartFlag** nor **AccessUnitEndFlag** are configured into the SL packet header this implies that each SL packet corresponds to a single access unit, hence both **accessUnitStartFlag** = **accessUnitEndFlag** = 1.

NOTE – When the SL packet header is configured to use **accessUnitStartFlag** but neither **accessUnitEndFlag** nor **accessUnitLength**, it is not guaranteed that the terminal can determine the end of an access unit before the subsequent one is received.

OCRflag – when set to one indicates that an **objectClockReference** will follow. The default value for **OCRflag** is zero.

idleFlag – indicates that this elementary stream will be idle (i.e., not produce data) for an undetermined period of time. This flag may be used by the decoder to discriminate between deliberate and erroneous absence of subsequent SL packets.

paddingFlag – indicates the presence of padding in this SL packet. The default value for **paddingFlag** is zero.

paddingBits – indicate the mode of padding to be used in this SL packet. The default value for **paddingBits** is zero.

If paddingFlag is set and paddingBits is zero, this indicates that the subsequent payload of this SL packet consists of padding bytes only. accessUnitStartFlag, randomAccessPointFlag and OCRflag shall not be set if paddingFlag is set and paddingBits is zero.

If paddingFlag is set and paddingBits is greater than zero, this indicates that the payload of this SL packet is followed by paddingBits of zero stuffing bits for byte alignment of the payload.

packetSequenceNumber – if present, it shall be continuously incremented for each SL packet as a modulo counter. A discontinuity at the decoder corresponds to one or more missing SL packets. In that case, an error shall be signalled to the sync layer user. If this syntax element is omitted from the SL packet header configuration, continuity checking by the sync layer cannot be performed for this elementary stream.

Duplication of SL packets: elementary streams that have a sequenceNumber field in their SL packet headers may use duplication of SL packets for error resilience. The duplicated SL packet(s) shall immediately follow the original. The packetSequenceNumber of duplicated SL packets shall have the same value and each byte of the original SL packet shall be duplicated, with the exception of an objectClockReference field, if present, which shall encode a valid value for the duplicated SL packet.

degPrioFlag - when set to one indicates that degradationPriority is present in this packet.

degradationPriority – indicates the importance of the payload of this SL packet. The streamPriority defines the base priority of an ES. degradationPriority defines a decrease in priority for this SL packet relative to the base priority. The priority for this SL packet is given by:

$$\text{SL_PacketPriority} = \text{streamPriority} - \text{degradationPriority}$$

degradationPriority remains at this value until its next occurrence. This indication may be for graceful degradation by the decoder of this elementary stream as well as by the adaptor to a specific delivery layer instance. The relative amount of complexity degradation among SL packets of different elementary streams increases as SL_PacketPriority decreases.

objectClockReference – contains an Object Clock Reference time stamp. The OTB time value t is reconstructed from this OCR time stamp according to the following formula:

$$t = (\text{objectClockReference}/\text{SL.OCRResolution}) + k * (2^{\text{SL.OCRLength}}/\text{SL.OCRResolution})$$

where k is the number of times that the objectClockReference counter has wrapped around.

objectClockReference is only present in the SL packet header if OCRflag is set.

NOTE – It is possible to convey just an OCR value and no payload within an SL packet.

The following is the semantics of the syntax elements that are only present at the start of an access unit when explicitly signaled by accessUnitStartFlag in the bitstream:

randomAccessPointFlag – when set to one indicates that random access to the content of this elementary stream is possible here. randomAccessPointFlag shall only be set if accessUnitStartFlag is set. If this syntax element is omitted from the SL packet header configuration, its default value is the value of SLConfigDescriptor.hasRandomAccessUnitsOnlyFlag for this elementary stream.

AU_sequenceNumber – if present, it shall be continuously incremented for each access unit as a modulo counter. A discontinuity at the decoder corresponds to one or more missing access units. In that case, an error shall be signalled to the sync layer user. If this syntax element is omitted from the SL packet header configuration, access unit continuity checking by the sync layer cannot be performed for this elementary stream.

Duplication of access units: elementary streams that have a AU_sequenceNumber field in their SL packet headers may use duplication of access units. The duplicated access unit(s) shall immediately follow the original. The AU_sequenceNumber of such access units shall have the same value and each byte of the original one or more SL packets shall be duplicated, with the exception of an objectClockReference field, if present, which shall encode a valid value for the duplicated access unit.

`decodingTimeStampFlag` – indicates that a decoding time stamp is present in this packet.

`compositionTimeStampFlag` – indicates that a composition time stamp is present in this packet.

`accessUnitLengthFlag` – indicates that the length of this access unit is present in this packet.

`instantBitrateFlag` – indicates that an `instantBitrate` is present in this packet.

`decodingTimeStamp` – is a decoding time stamp as configured in the associated `SLConfigDescriptor`. The decoding time `td` of this access unit is reconstructed from this decoding time stamp according to the formula:

$$td = (\text{decodingTimeStamp}/\text{SL.timestampResolution} + k * 2^{\text{SL.timestampLength}}/\text{SL.timestampResolution})$$

where `k` is the number of times that the `decodingTimeStamp` counter has wrapped around.

A `decodingTimeStamp` shall only be present if the decoding time is different from the composition time for this access unit.

`compositionTimeStamp` – is a composition time stamp as configured in the associated `SLConfigDescriptor`. The composition time `tc` of the first composition unit resulting from this access unit is reconstructed from this composition time stamp according to the formula:

$$td = (\text{compositionTimeStamp}/\text{SL.timestampResolution} + k * 2^{\text{SL.timestampLength}}/\text{SL.timestampResolution})$$

where `k` is the number of times that the `compositionTimeStamp` counter has wrapped around.

`accessUnitLength` – is the length of the access unit in bytes. If this syntax element is not present or has the value zero, the length of the access unit is unknown.

`instantBitrate` – is the instantaneous bit rate in bits per second of this elementary stream until the next `instantBitrate` field is found.

10.2.5 Clock Reference Stream

An elementary stream of `streamType = ClockReferenceStream` may be declared by means of the object descriptor. It is used for the sole purpose of conveying Object Clock Reference time stamps. Multiple elementary streams in a name scope may make reference to such a `ClockReferenceStream` by means of the `OCR_ES_ID` syntax element in the `SLConfigDescriptor` to avoid redundant transmission of Clock Reference information. Note, however, that circular references between elementary streams using `OCR_ES_ID` are not permitted.

On the sync layer a `ClockReferenceStream` is realized by configuring the SL packet header syntax for this SL-packetized stream such that only OCR values of the required `OCRresolution` and `OCRlength` are present in the SL packet header.

There shall not be any SL packet payload present in an SL-packetized stream of `streamType = ClockReferenceStream`.

In the `DecoderConfigDescriptor` for a clock reference stream `ObjectTypeIndication` shall be set to '`0xFF`', `hasRandomAccessUnitsOnlyFlag` to one and `bufferSizeDB` to '`0`'.

The following indicates recommended values for the `SLConfigDescriptor` of a Clock Reference Stream:

Table 53 – SLConfigDescriptor parameter values for a ClockReferenceStream

| | |
|---------------------------------------|---|
| <code>useAccessUnitStartFlag</code> | 0 |
| <code>useAccessUnitEndFlag</code> | 0 |
| <code>useRandomAccessPointFlag</code> | 0 |
| <code>usePaddingFlag</code> | 0 |

| | |
|---------------------------|---|
| useTimeStampsFlag | 0 |
| useIdleFlag | 0 |
| durationFlag | 0 |
| timeStampResolution | 0 |
| timeStampLength | 0 |
| AU_length | 0 |
| degradationPriorityLength | 0 |
| AU_seqNumLength | 0 |

10.2.6 Restrictions for elementary streams sharing the same object time base

While it is possible to share an object time base between multiple elementary streams through OCR_ES_ID, a number of restrictions for the access to and processing of these elementary streams exist as follows:

1. When several elementary streams share a single object time base, the elementary streams without embedded object clock reference information shall not be used by the player, even if accessible, until the elementary stream carrying the object clock reference information becomes accessible (see 8.7.3 for the stream access procedure).
2. If an elementary stream without embedded object clock reference information is made available to the terminal at a later point in time than the elementary stream carrying the object clock reference information, it shall be delivered in synchronization with the other stream(s). Note that this implies that such a stream might not start playing from its beginning, depending on the current value of the object time base.
3. When an elementary stream carrying object clock reference information becomes unavailable or is otherwise manipulated in its delivery (e.g., paused), all other elementary streams which use the same object time base shall follow this behavior, i.e., become unavailable or be manipulated in the same way.
4. When an elementary stream without embedded object clock reference information becomes unavailable this has no influence on the other elementary streams that share the same object time base.

10.2.7 Usage of configuration options for object clock reference and time stamp values

10.2.7.1 Resolution of ambiguity in object time base recovery

Due to the limited length of objectClockReference values these time stamps may be ambiguous. The OTB time value can be reconstructed each time an objectClockReference is transmitted in the headers of an SL packet according to the following formula:

$$t_{OTB_reconstructed} = (\text{objectClockReference}/SL.\text{OCRResolution}) + k * (2^{SL.\text{OCRLength}}/SL.\text{OCRResolution})$$

with k being an integer value denoting the number of wrap-arounds. The resulting time base $t_{OTB_reconstructed}$ is measured in seconds.

When the first objectClockReference for an elementary stream is acquired, the value k shall be set to one. For each subsequent occurrence of objectClockReference the value k is estimated as follows:

The terminal shall implement a mechanism to estimate the value of the object time base for any time instant.

Each time an objectClockReference is received, the current estimated value of the OTB $t_{OTB_estimated}$ shall be sampled. Then, $t_{OTB_rec}(k)$ is evaluated for different values of k. The value k that minimizes the term $|t_{OTB_estimated} - t_{OTB_rec}(k)|$ shall be assumed to yield the correct value of $t_{OTB_reconstructed}$. This value may be used as new input to the object time base estimation mechanism.

The application shall ensure that this procedure yields an unambiguous value of k by selecting an appropriate length and resolution of the objectClockReference element and a sufficiently high frequency of insertion of objectClockReference values in the elementary stream. The choices for these values depend on the delivery jitter for SL packets as well as the anticipated maximum drift between the clocks of the transmitting and receiving terminal.

10.2.7.2 Resolution of ambiguity in time stamp recovery

Due to the limited length of decodingTimeStamp and compositionTimeStamp values these time stamps may become ambiguous according to the following formula:

$$t_{ts}(m) = (\text{TimeStamp} / \text{SL.timeStampResolution}) + m * (2^{\text{SL.timestampLength}} / \text{SL.timeStampResolution})$$

with TimeStamp being either a decodingTimeStamp or a compositionTimeStamp and m being an integer value denoting the number of wrap-arounds.

The correct value $t_{timestamp}$ of the time stamp can be estimated as follows:

Each time a TimeStamp is received, the current estimated value of the OTB $t_{OTB_estimated}$ shall be sampled. $t_{ts}(m)$ is evaluated for different values of m. The value m that minimizes the term $|t_{OTB_estimated} - t_{ts}(m)|$ shall be assumed to yield the correct value of $t_{timestamp}$.

The application may choose, separately for every individual elementary stream, the length and resolution of time stamps so as to match its requirements on unambiguous positioning of time events. This choice depends on the maximum time that an SL packet with a TimeStamp may be sent prior to the point in time indicated by the TimeStamp as well as the required precision of temporal positioning.

10.2.7.3 Usage considerations for object clock references and time stamps

The time line of an object time base allows to discriminate two time instants separated by more than $1/\text{SL.OCRResolution}$. OCRResolution should be chosen sufficiently high to match the accuracy needed by the application to synchronize a set of elementary streams.

The decoding and composition time stamp allow to discriminate two time instants separated by more than $1/\text{SL.timeStampResolution}$. timeStampResolution should be chosen sufficiently high to match the accuracy needed by the application in terms of positioning of access units for a given elementary stream.

A TimestampResolution higher than the OCRResolution will not achieve better discrimination between events. If TimestampResolution is lower than the OCRResolution, events for this specific stream cannot be positioned with the maximum precision possible with this given OCRResolution.

The parameter OCRLength is signaled in the SL header configuration. $2^{\text{SL.OCRLength}} / \text{SL.OCRResolution}$ is the time interval covered by the objectClockReference counter before it wraps around. OCRLength should be chosen sufficiently high to match the application needs for unambiguous positioning of time events from a set of elementary streams.

When an application knows the value k defined in 10.2.7.1, the OTB time line is unambiguous for any time value. When the application cannot reconstruct the k factor, as for example in any application that permits random access without additional side information, the OTB time line is ambiguous modulo $2^{\text{SL.OCRLength}} / \text{SL.OCRResolution}$. Therefore, any time stamp referring to this OTB is ambiguous. Therefore, any time stamp referring to this OTB is ambiguous. It may, however, be considered unambiguous within an application environment through knowledge about the maximum expected delivery jitter and constraints on the time by which an access unit can be sent prior to its decoding time.

Note that elementary streams that choose the time interval $2^{\text{SL.timestampLength}} / \text{SL.timeStampResolution}$ higher than $2^{\text{SL.OCRLength}} / \text{SL.OCRResolution}$ can still only position time events unambiguously in the smaller of the two intervals.

In cases, where k and m can not be estimated correctly, the buffer model may be violated, resulting in unpredictable performance of the decoder.

EXAMPLE — Let's assume an application that wants to synchronize elementary streams with a precision of 1 ms. OCRResolution should be chosen equal to or higher than 1000 (the time between two successive ticks of the OCR is then equal to 1ms). Let's assume OCRResolution=2000.

The application assumes a drift between the STB and the OTB of 0.1% (i.e. 1ms every second). The clocks need therefore to be adjusted at least every second (i.e. in the worst case, the clocks will have drifted 1ms which is the precision constraint). Let's assume that objectClockReference are sent every 1s.

ISO/IEC 14496-1:2001(E)

The application wants to have an unambiguous OTB time line of 24h without need to reconstruct the k factor. The OCRLength is therefore chosen accordingly such that $2^{SL.OCRLength}/SL.OCRResolution=24h$.

Let's assume now that the application wants to synchronize events within a single elementary stream with a precision of 10 ms. TimeStampResolution should be chosen equal to or higher than 100 (the time between two successive ticks of the TimeStamp is then equal to 10ms). Let's assume TimeStampResolution=200.

The application wants to be able to send access units at maximum 1 minute ahead of their decoding or composition time. The timeStampLength is therefore chosen as

$$2^{SL.timeStampLength}/SL.timeStampResolution = 2 \text{ minutes.}$$

10.3 DMIF Application Interface

The DMIF Application Interface is a conceptual interface that specifies which data need to be exchanged between the sync layer and the delivery mechanism. Communication between the sync layer and the delivery mechanism includes SL-packetized data as well as additional information to convey the length of each SL packet.

An implementation of ISO/IEC 14496-1 does not have to expose the DMIF Application Interface. A terminal compliant with ISO/IEC 14496-1, however, shall have the functionality described by the DAI to be able to receive the SL packets that constitute an SL-packetized stream. Specifically, the delivery mechanism below the sync layer shall supply a method to frame or otherwise encode the length of the SL packets transported through it.

The DMIF Application Interface specified in ISO/IEC 14496-6 embodies a superset of the required data delivery functionality. The DAI has data primitives to receive and send data, which include indication of the data size. With this interface, each invocation of a DA_Data or a DA_DataCallback shall transfer one SL packet between the sync layer and the delivery mechanism below.

11 MPEG-J

11.1 Introduction

MPEG-J is a flexible programmatic control system that represents an audio-visual session in a manner that allows the session to adapt to the operating characteristics when presented at the terminal. Two important characteristics are identified, first, the capability to allow graceful degradation under limited or time varying resources, and second, the ability to respond to user interaction and provide enhanced multimedia functionality.

This part of the document specifies the format, delivery, interactions and behavior of Java byte code to the MPEG-4 player. More specifically:

- The format and delivery are normatively specified by specifying the MPEG-J stream format and the delivery mechanism of such a stream (Java byte code and associated data).
- MPEG-J Session and the application lifecycle
- The interactions and behavior of byte code is normatively defined through the Java APIs.

11.1.1 Organization of this document

Subclause 0 gives an overall architecture of the MPEG-J system. MPEG-J Session start up is walked through in subclause 11.3. The Delivery of MPEG-J data to the terminal is specified in subclause 11.4. Subclause 11.5 specifies the different categories of APIs that a program in the form of Java bytecode would use. **Annex S** is an informative annex on starting the Java Virtual Machine. **Annex V** of this document gives normative javadoc listings of the MPEG-J APIs in the word97 format, while **Annex U** gives the same in the HTML format. **Annex T** illustrates the usage of MPEG-J APIs through a few examples.

11.2 Architecture

11.2.1 Parametric versus Programmatic System

11.2.1.1 Overview of a Parametric MPEG-4 System

Figure 29 shows an example of the basic MPEG-4 player, a parametric system. MPEG-4 coded data from storage/network goes through a DMIF and a demultiplex layer. In the demultiplex layer, FlexMux-PDUs pass through the Sync Layer resulting in unformatted SL-PDUs of each media type (coded audio, video, speech or facial animation streams) which are then buffered in the respective decoder buffers and are offered to the corresponding media decoders. Also, the SL-PDUs corresponding to scene description representation are input to the BIFS decoder, the output of which goes to the Scene Graph. The output of the media decoders as well as Scene Graph feeds the Compositor and the Renderer, which may respond to (very basic) user interaction such as mouse clicks etc. The output of Compositor and Renderer is the scene for presentation.

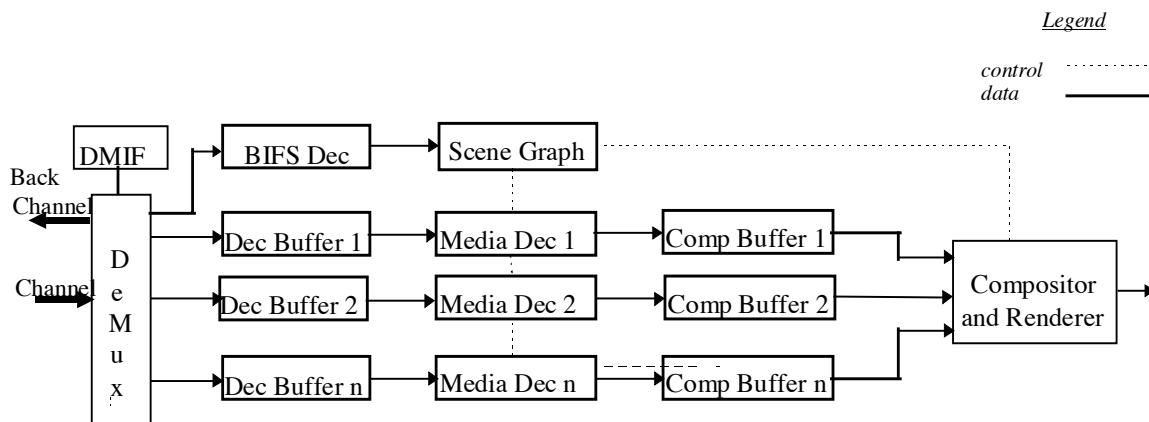


Figure 29 - An MPEG-4 Player

11.2.2 The MPEG-J System

The MPEG-J is a programmatic system, which specifies interfaces for interoperation of an MPEG-4 media player with Java code. By combining MPEG-4 media and safe executable code, content creators may embed complex control mechanisms with their media data to intelligently manage the operation of the audio-visual session. Java byte code is delivered to the MPEG-4 terminal as a separate elementary stream. There, it will be directed to the MPEG-J run time environment, which includes a Java Virtual Machine, from where the MPEG-J program will have access to the various components of the MPEG-4 player. Figure 30 shows an example of the components of the MPEG-J operating environment.

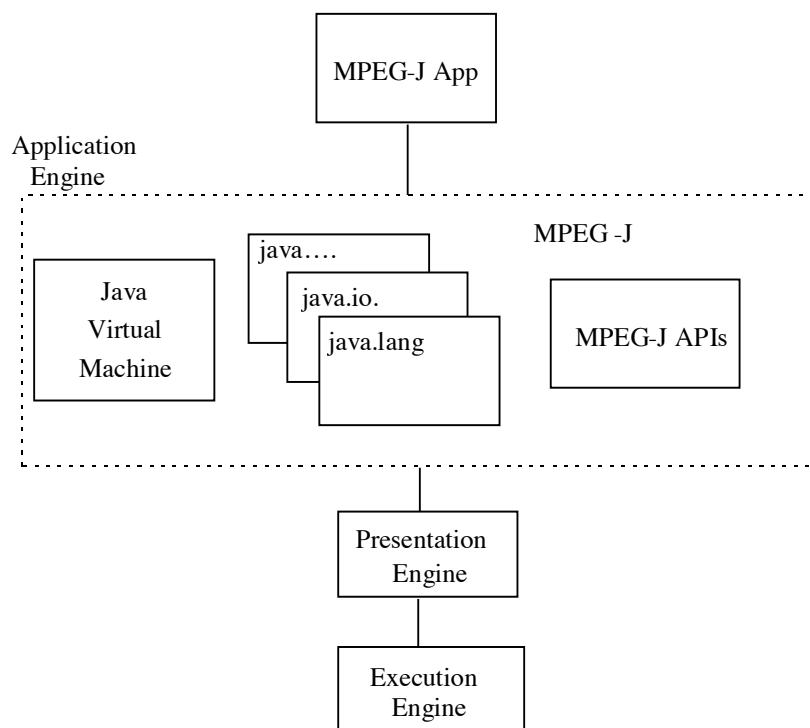


Figure 30 - MPEG-J Software architecture

The software architecture of MPEG-J takes into consideration the resources available on the underlying platform. The architecture involves the isolation of distinct *components*, the design of interface that reflects them, and the characterization of interactions between components. Such components include:

Execution and Presentation Resources: It is assumed that the decoding and presenting resources are limited. This component abstracts access to information on such static and dynamic resources in the player. It abstracts notification during changes in such resources. Further, it provides for some minimal control of the same.

Decoders: This component abstracts the media decoders used to decode the received media streams. The programmatic control and their manipulation to add extra functionality is also abstracted by this component.

Network Resources: Since the device receives media streams, this component abstracts the control of such streams. It also abstracts the media pipeline, which transports and presents the stream.

Scene Graph: An MPEG-4 session has a Scene Graph which spatially and temporally represents audio visual objects. This component abstracts access and control of the scene graph.

The MPEG-J APIs specified in this document are the interfaces that reflect the above said components. A block diagram of the MPEG-J player controlling an MPEG-4 player environment is shown in Figure 31. The lower half of this drawing depicts the parametric MPEG-4 player of Figure 1 and is also referred to as the Presentation Engine. The upper half of Figure 31 illustrates this the MPEG-J system controlling the Presentation Engine is also referred to as the Application Engine.. The APIs shown in Figure 31 will be specified later in this document.

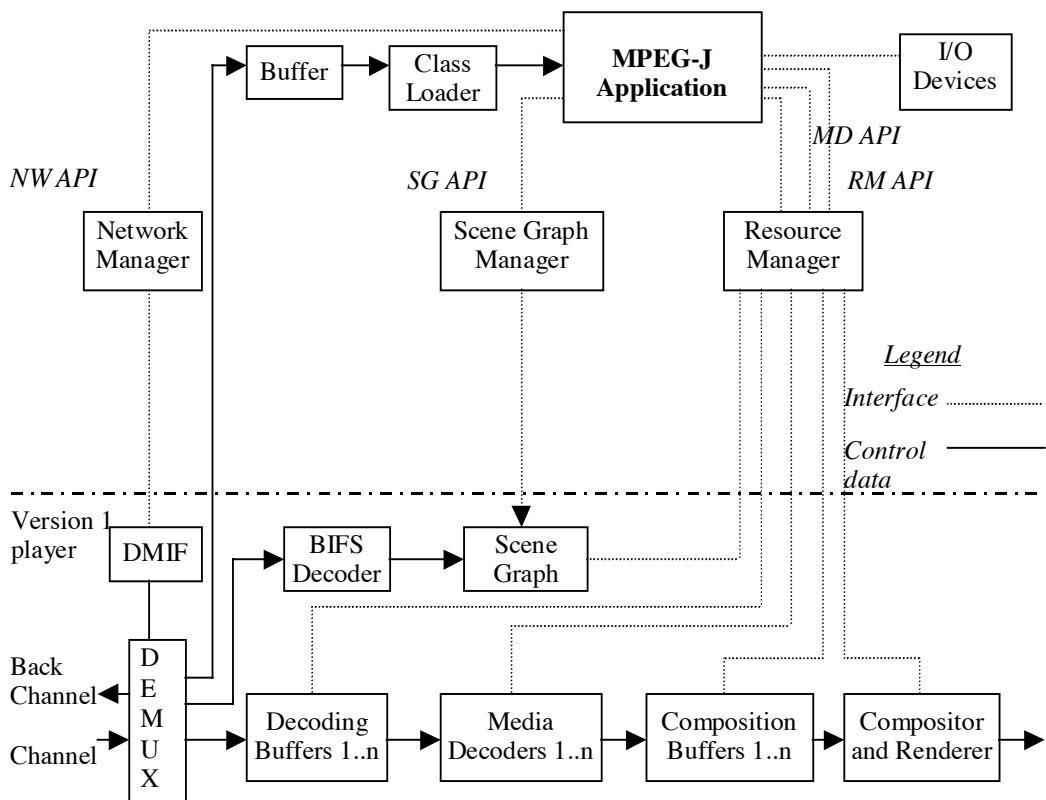


Figure 31 - Architecture of an MPEG-J enabled MPEG-4 System

11.3 MPEG-J Session

The MPEG-J session need not be started till it is clear that MPEG-J application programs will be received and are to be executed. This can be recognized by the presence of one or more of MPEG-J Elementary streams.

11.3.1 Walkthrough of an MPEG-J Session Start-up

The MPEG-J session is initiated when the MPEG-4 player receives an MPEG-J Object Descriptor. The player takes the following steps:

It opens the MPEG-J elementary stream via a DMIF channel. The MPEG-J Elementary stream is a SL packetized stream, similar to all other MPEG-4 streams.

It delivers the Access Units to the class loader, which loads the classes.

The MPEG-J "decoder" receives the arriving Access Units (it "decodes" them). There can be more than one class with an entry point within one MPEG-J stream. Each time such a class containing an entry-point is received (a "run" method) execution will start there as a new thread.

11.3.2 Local and Remote MPEG-J Applications

MPEG-J application that uses the MPEG-J APIs to control the underlying MPEG-4 player can either be local or remote. In the case of a remote application that is received in the MPEG-J Elementary Stream, it must implement the MPEGlet interface. The lifecycle and the security model of such an application (MPEGlet) are described in the next two sections. However, this does not apply to local applications.

11.3.3 MPEG-J Elementary Stream, Object Descriptor, and the Name Scope

11.3.3.1 MPEG-J Elementary Stream

The MPEG-J data comprising of class files or object data is streamed to the MPEG-J terminal as an MPEG-J Elementary Stream. The class files and all the associated data in such a stream can be optionally packaged

together. Further, the class files in the stream (irrespective of whether it is packaged or not, can be compressed. The stream type of such an elementary stream is uniquely defined in Table 9 of this document.

11.3.3.2 MPEG-J Object Descriptor

The MPEG-J elementary stream and the application programs (MPEGlets) derive their scope and properties from its Object Descriptor, which in turn is scoped by the initOD or the updateOD of the scene.

11.3.3.3 The Name Scope of an MPEG-J Stream

The Name Scope of the MPEGlets in an MPEG-J Stream is derived from the Object Descriptor of that MPEG-J Elementary Stream. Similar to the node identifiers in the scene graph, all the identifiers used by an MPEGlet in an Elementary Stream are interpreted within the name scope of that Elementary Stream and its Object Descriptor. Therefore, all the rules that restrict the name scope of an inline scene apply to the MPEG-J session also.

The name scope of an MPEGlet is determined by the managers it receives from the MpegjTerminal. The MPEGlet must pass a reference to itself in the constructor of the MpegjTerminal to identify the name scope used by the managers. A local application may use the zero-argument constructor of the MpegjTerminal to imply that the managers should use the root name scope.

11.3.4 Life Cycle of an MPEGlet

The life cycle of an MPEGlet is very similar to that of an applet. The MPEGlet interface has init(), run(), stop(), and destroy() methods. When an MPEGlet is received in the bitstream, it is loaded after the Start-Loading Time Stamp and before the Load-By Time Stamp as described in section 11.4.2. At the time instant specified by the Load-By Time Stamp, the init() method of the MPEGlet is executed. This is where all the initializations for the MPEGlet are typically done. After initializing the MPEGlet, the run method is called as a separate thread. Similar to a Java applet, the stop() and destroy() methods are specified in the MPEGlet interface. If the MPEG-J player receives another MPEGlet in the bitstream, it is initialized and started as a different thread.

11.3.5 Security Model of an MPEGlet

The security model of an MPEGlet is very similar to that of an applet. However, the security manager implemented on the player can add or relax the security restrictions. By default all the security restrictions that apply to applets apply to the MPEGlets too. These default security restrictions of an MPEGlet are:

- MPEGlets cannot load libraries or define native methods.
- MPEGlets can use only their own Java code, MPEG-J APIs, and the Java APIs the underlying platform provides.
- An MPEGlet cannot normally read or write files on the host that is executing it.
- An MPEGlet cannot start any program on the host that is executing it.
- An MPEGlet cannot read certain system properties except through the Terminal Capability APIs.

11.4 Delivery of MPEG-J Data

The MPEG-J application programs are delivered to the MPEG-4 player as MPEG-4 elementary streams defined in this document. The MPEG-J data could be classes, serialized objects, or any associated data (in the case of packaged form). Serialized objects and other auxiliary data are expected to accompany classes that have knowledge about handling those objects.

11.4.1 Issues in Delivery of Byte Code

The MPEG-J data (classes or objects) must be delivered in a timely fashion to the player. A header is used along with the class files or objects (serialized) to ensure this. This header, which is called the Java Stream Header, is attached to each class file or object data before it is passed on to the Sync Layer. After packetization, any “time aware” transport mechanism, like FlexMux, RTP, and even MPEG2 transport stream, can be used to transport the data to the client side.

11.4.1.1 Packet Loss

Packet loss in the case of Java byte code streaming will be a problem for the execution of the programs. The possible options for dealing with data loss are:

Retransmission of the entire class at regular intervals in the absence of a back channel. This would also help to facilitate random access points in the case of media. However, this may not be possible when there are a large number of clients or when the class (or object) is huge, making retransmission prohibitive.

When a back channel is present this loss can be signaled to the server and the lost packet can be retransmitted. There are a number of error resilient schemes, with built-in redundancy, available to recover from a partial loss of data. For e.g., schemes like forward error correction can be used. However, currently none of these schemes are mandated in an MPEG-J stream.

Packet Loss is not handled at the MPEG-J layer. It is assumed that the underlying transport layer is reliable enough to ensure that there is no packet loss.

11.4.1.2 Security

To ensure the safety of the client, the byte code needs to be authentic. There are a number of security schemes that can be used to ensure the authenticity of the byte code. Any of these schemes can be accommodated in an IPMP Descriptor or an IPMP stream.

11.4.1.3 Compression

The Java byte code can be optionally compressed for bandwidth efficiency using the Zip compression mechanism. Files can be both compressed and uncompressed using the `java.util.zip` package. The underlying compression technique in Zip is ZLIB.²⁾

11.4.1.4 Class Dependency

If a given class depends on other classes, the classes that it depends on have to be loaded before the dependent class can be loaded. Similarly before an object can be instantiated, the class of which it is an instance must be loaded first. One way of doing this would be using a packaging scheme e.g. JAR to package all the interdependent class files together. However, this may not always be the optimal solution, especially in lossy transport channels as a single packet loss could result in a loss of the entire package. As an alternative a simple class-dependency mechanism is provided in the Java Stream header below. In this mechanism all the dependent classes of a particular class are listed in the header of that class file. It is required that those classes need to be loaded before this class can be loaded.

Two time stamps will be used in the next subsection, one signaling a time after which a particular class can be loaded (also called Start-Loading Time Stamp), and the second signaling the time by which the class is required to be loaded (Load-By Time Stamp). The Start-Loading Time Stamp of a class that depends on a number of other classes has to be later than the Load-By Time Stamps of all the classes it depends on. These two timestamps together aid in ensuring that the dependencies between classes are met.

11.4.2 Semantics of Time Stamps in MPEG-J

The Decoding Time Stamp (DTS) and Composition Time Stamp (CTS) defined in the SL header in the Sync Layer will be used for the timely delivery of the MPEG-J Elementary Stream. The semantics of these timestamps for the MPEG-J Elementary Stream is defined in this section.

Start-Loading Time Stamp: This is used to signal the time instant at which the process of loading a class can be started. This time stamp is essential to avoid name space and resource conflicts. This timestamp also ensures that the resources for loading the class would be available at the terminal. In addition, this time stamp allows the terminal to receive classes ahead of the time at which they need to be loaded. This is carried in the SL Header as the Decoding Time stamp (DTS).

²⁾ More information about ZLIB can be found at the ZLIB Home Page <http://www.gzip.org/zlib>: ZLIB is the underlying compression mechanism used by both gzip and zip.

Each class is loaded by calling the `loadClass(className)` method of the class loader, where `className` is the name of the class. The name of class does not include the `.class` suffix.

Load-By Time Stamp: This time stamp is used to signal the time instant by which a class should be loaded at the MPEG-J terminal. If the received class implements the MPEGlet interface, it will also be initialized at this instant of time (by executing the `init()` method). After initialization, the MPEGlet would be run (by executing the `run()` method) as a separate thread at this time instant. This time stamp is carried in the SL Header as the Composition Time Stamp (CTS).

The above two time stamps define a window in time between which a given class shall be loaded. As described in the previous section this window helps in resolving the class dependencies between classes. When the window between these two timestamps are made large enough the problems due to non-uniform loading times on different client terminals can be avoided. Again, if the channel is lossy, this window can be made large enough to allow re-transmissions, if possible. With this mechanism the order in which the classes need to be loaded can be different from the order in which the classes arrive on the terminal.

11.4.3 Streaming Header

11.4.3.1 Description

Each class or a packaged set constitutes a separate Access Unit.

The payload can be classes (compressed or uncompressed) or instances as serialized objects.

Classes are identified by an ID (unique to the session). This ID can be used to identify classes when it is received multiple times. The ID of a class is also used to identify all its instances in the case of serialized objects. Java class names are used as IDs. Since these are variable length strings, the length of the string is also included in the header. The combination of the Class ID and its length (16 bits) are padded till the next 32 bit boundary. When multiple classes are packaged together, the name of the packaged file is used as the ID. There is a list of required classes, whose Load-By time need to precede the Start-Loading time of a class that requires it. A 13-bit number is used to specify the number of classes that are required before loading/instantiating the class/object data. Each required class is specified by its Class IDs and its length. In the packaged case, the list of required classes specify the classes in the archive that have to be loaded. Those files in the archive that are not listed as required classes need not be loaded by the terminal by the DTS or Load-By time.

11.4.3.2 JavaStreamHeader

11.4.3.2.1 Syntax

```
aligned(32) class JavaStreamHeader {
    bit(2) version;
    bit(1) isClassFlag;
    bit(13) numReqClasses;
    bit(1) isPackaged ;
    bit(3) compressionScheme;
    bit(12) reserved;
    JavaClassID classID;

    JavaClassID reqClassID[numReqClasses];
}
```

11.4.3.2.2 Semantics

version - Version number. This is currently 00.

isClassFlag – If set to 1, the payload represents a class. If set to zero, the payload does not represent a class, but instead represents content accessible to the MPEGlet as a ClassLoader resource. This content can be a java object or any other data that is useful to the MPEGlet. The MPEGlet may obtain a URL to access the content by calling the `getResource()` method of the ClassLoader with the `JavaClassID` as the parameter. In addition, if **isClassFlag** is set to 1 but **isPackaged** indicates a package, the Zip archive may contain content that does not represent class data. Such data shall be accessible by calling `getResource()` of the ClassLoader with the element name as the parameter.

numReqClasses - Number of classes that are required before loading this class (or before instantiation, in case of objects).

isPackaged – If set to 0, this indicates a single class file and not a package. 1 indicates that multiple class files are packaged together using Zip.

compressionScheme - To specify the type of compression scheme used (000 for objects, when no compression is used, 001 when the contents are compressed using Zip, 010-111 reserved for future use by ISO).

reserved – Bits reserved by ISO for future use. These bits should be 0xFFFF.

classID – Information to identify this class or package. The definition of its type JavaClassID is defined in the next subsection.

reqClassID[n] – Information to identify the n required classes.

11.4.3.3 JavaClassID

11.4.3.3.1 Syntax

```
aligned(32) class JavaClassID {
    bit(16) length;
    bit(8 * length) ID;
}
```

11.4.3.3.2 Semantics

length - Number of bytes for the ID.

ID - Variable length string that identifies the class. The string is padded, so that the length of the combination of ID length field and the ID is multiple of 32 bits.

11.5 MPEG-J API List

11.5.1 Packages for MPEG-J from MPEG

Packages are a means to organize the implementation of APIs. The MPEG-J APIs are organized as the following packages:

org.iso.mpeg.mpegj.mpegj

org.iso.mpeg.mpegj.scene

org.iso.mpeg.mpegj.resource

org.iso.mpeg.mpegj.network

org.iso.mpeg.mpegj.decoder

Table 54 - Categories of APIs

| No | API Category and main classes/interfaces | Explanation |
|----|---|---|
| 1. | Scene Scene Graph | Means by which MPEG-J applications access and manipulate the scene graph |
| 2. | Resource ResourceManager CapabilityManager | Centralized facility for managing system resources Access to the static and dynamic capabilities of the terminal. |
| 3. | Media Decoders MPDecoder | Access and control to the decoders used to decode the audio-visual objects. |
| 4. | Network NetworkManager | Access and control of the network components of the MPEG-4 player. |
| 5. | Section Filtering and Service Information | MPEG-2 Stream specific APIs defined in Part 9 of DAVIC 1.4.1 specification. This covers Section Filtering, Service Information, Resource Notification, and MPEG Component APIs. |

11.5.2 MPEG-J API (org.iso.mpeg.mpegj)

The MPEG-J Terminal class provides the information about the managers that are implemented in the terminal. Each MPEGlet or application instantiates a new MpegjTerminal once it is loaded. This has methods to gain access to all the managers, viz., SceneManager, ResourceManager, and the NetworkManager.

Although an MPEG-J Terminal is instantiated by each MPEGlet, it should not be interpreted as creating a new terminal for each MPEGlet. A MPEG-J Terminal implementation gives the appropriate managers to the MPEGlet. The terminal, along with the managers, controls the environment (for e.g. the name scope) of the MPEGlet.

The ObjectDescriptor, the ESDescriptor, and the DecoderConfigDescriptor interfaces are also part of the org.iso.mpeg.mpeg.mpegj package. These interfaces provide access and abstraction to the above descriptors. Information about nodes, elementary streams, their types, and the decoder information can be obtained used these APIs.

11.5.3 Scene API

The SceneGraph API provides a mechanism by which MPEG-J applications access and manipulate the scene used for composition by the BIFS player. It is a low-level interface, allowing the MPEG-J application to monitor events in the scene, and modify the scene tree in a programmatic way. Nodes may also be created and manipulated, but only the fields of nodes that have been instanced with DEF are accessible to the MPEG-J application.

This API has been designed to serve as the lowest layer of the MPEG-J scene graph manager. A terminal designer would only need to implement this package to have MPEG-J bindings to the native scene. Other class libraries could be specified entirely in Java to allow higher-level access to and control of the scene. Those libraries could be supplied as packages that run above this org.iso.mpeg.mpegj.scene package, allowing their selection to be determined based on a profile or level or could sent to the terminal in the bit stream.

11.5.3.1 Events

Events in the BIFS scene graph are identified by the two interface classes EventIn and EventOut. The EventOutListener class can monitor them.

11.5.3.1.1 EventIn

The EventIn interface class contains an interface class definition for each node type defined in MPEG-4 systems. These definitions enumerate all of the exposedField and eventIn field types in the node, in the order they are defined in this document.

11.5.3.1.2 EventOut

Likewise, the EventOut interface class contains an interface class definition for each node type defined in MPEG-4 systems. These definitions enumerate all of the exposedField and eventOut field types in the node, in the order they are defined in this document.

11.5.3.1.3 EventOutListener

The Scene Graph APIs also provide an EventOutListener interface, which can be used by the scene graph manager to identify a field value change when an eventOut is triggered.

11.5.3.2 Field Values

The scene graph APIs provide an interface for tagging objects that can return a field value. Similar to VRML, two general field types are supported. SFField is used for single value fields and MFField is used for multiple value fields. The supported SFField types are extended directly from the FieldValue interface, while the Multiple field types are extended through the MFFieldValue interface.

11.5.3.3 Scene Management

The following interfaces are used to facilitate programmatic control over the MPEG-4 terminal's native scene.

11.5.3.3.1 SceneManager

The SceneManager interface is the interface that allows access to the native scene. It contains methods for adding and removing a SceneListener. In order to access the BIFS scene graph, the SceneManager requires an instance of the scene, which it obtains through notification on a SceneListener instance. This method is the only normative way for an MPEG-J application to obtain a scene instance.

11.5.3.3.2 SceneListener

The SceneListener contains a notify method which can be called by the SceneManager when the BIFS scene has changed. The notify() method contains arguments to indicate the nature of the change, and an updated Scene instance. Currently three states can be passed through the scene listener. They indicate that the scene is ready, it has been replaced, or it has been removed.

11.5.3.3.2.1 Scene

The Scene interface acts as a proxy for the BIFS scene. It contains a getNode() method, which returns a Node proxy for the desired node in the scene. If the requested node does not exist it throws a BadParameterException, and if the scene is no longer valid it throws an InvalidSceneException.

11.5.3.3.2.2 Node

The Node interface acts as a proxy for a BIFS node in the scene graph. As previously mentioned, only nodes that have been instanced by a DEF identifier are available to the MPEG-J application. Three methods are available in the Node proxy for monitoring output events. The getEventOut() method reads the current value of an eventOut or exposedField of this node. There are also methods for adding and removing an EventOutListener. All three of these methods throw a BadParameterException if they fail. The fourth method contained in the Node interface is the sendEventIn method. This is the only method available to the application for modifying the BIFS scene. It updates the value of the eventIn or exposedField of the node. It is a synchronous call that will not return until the field is updated in the scene. The fifth method contained in the Node interface is the getNodeType() method. This method returns an integer identifying the type of the node (such as Transform). The node type constants are defined in the NodeType interface. All of the methods contained in the Node interface throw an InvalidNodeException if the node is no longer valid (if it has been replaced or deleted).

11.5.3.3.2.3 NodeValue

The NodeValue interface is used to represent the values of SFNode and MFNode fields. There are three types of NodeValue references:

- The getNode() method of the Scene interface returns a Node that acts as a proxy for a node in the BIFS scene. This object also implements the NodeValue interface.

- The `getEventOut()` method of the `Node` interface may return a `SFNodeFieldValue`. Its `getSFNodeValue` method returns a `nodeValue` that acts as a proxy for a child node in the `BIFS` scene. However, unlike the proxy returned by the `Scene`'s `getNode` method, this proxy does not provide any way to access or modify the child node.
- The `NewNode` interface extends `nodeValue` to support creation of new nodes. This interface has methods that describe the structure of the new node.
- Sending an `eventIn` to a `SFNode` field (such as the `geometry` field of a `Shape` node) replaces a sub-graph of a `BIFS` scene. The value sent to the `eventIn` may be any one of the three types of `nodeValue` references enumerated above. If the value is a proxy for a node or child node, then the `SFNode` field value becomes a reference to the existing node (equivalent to making a `USE` reference to the node). If the object implements the `NewNode` interface, then a new node is created. The node type and `DEF` identifier of the new node are determined by calling the `getNodeType()` and `getNodeID()` methods (the node is not given a `DEF` identifier if the `getNodeID()` method returns zero). If the `DEF` identifier is already in use within the scene, then a `BadParameterException` shall be thrown. Each field and `exposedField` of the node shall be initialized to the value returned by calling `getField()` with the appropriate field `defID` (or the field's default value if null is returned). This algorithm is applied recursively in the case that the field or `exposedField` is a `SFNode` or `MNNode`. The recursion may form a directed acyclic graph if the same object is returned more than once.

11.5.4 Resource API

Program execution may be contingent upon the terminal configuration and its capabilities. An MPEG-J program may need to be aware of its environment, so that it is able to adapt its own execution and the execution of the various components, as they may be configured and running in the MPEG-4 terminal. The APIs in the `org.iso.mpeg.mpegj.resource` package can be used to monitor the system resources, to listen to exceptional conditions through the event mechanism, and handle such eventualities. The resource package helps the MPEG-4 session to adapt itself to varying terminal resources. The main components of the resource package are the Resource Manager and the event model, capability manager to monitor dynamic and static capabilities of the terminal and the terminal profile manager.

11.5.4.1 Resource Manager

The resource manager API is used for regulation of performance. This provides a centralized facility for managing resources. It is a collection of a number of classes and interfaces summarized as follows.

| Interfaces | Classes | Interfaces |
|---|---|---|
| | Renderer ResourceManager | |
| MPDecoderEventGenerator MPRendererEventGenerator | MPDecoderMediaEvents MPRendererMediaEvents | MPDecoderMediaListener MPRendererMediaListener |

11.5.4.1.1 Overview of the Event Model

For each decoder the Resource Manager would have an instantiation of a class that implements `MPDecoder` or a sub-interface. These decoder instantiations generate the different defined events for different conditions in the terminal. The resource manager implementation can handle events if necessary in addition to the event handlers in the application (the order of which is left to the implementation). The MPEG-J application can receive the Event handlers as byte code in the bit stream. The Renderer optionally provides notification of exceptional conditions (during rendering) and notification of frame completion when an application registers with it for this.

Apart from implicitly specifying the above event model the Resource Manager interface also provides access to the capability manager, decoders and their priorities. Given a node in the scene graph, this interface provides access to the decoder associated with that node (through its `OD` and `ESID`). It also facilitates setting and getting decoder priorities. It also enables changing a decoder associated with a node.

11.5.4.2 Capability Manager

The Terminal Capability API is responsible for providing access to dynamic and static terminal resources. The separation between static and dynamic terminal capabilities has been reflected in the API (the `StaticCapability` and the `DynamicCapability` interfaces). Because applications need to be notified when terminal capabilities change, an additional interface named `TerminalObserver` has been defined. The `CapabilityManager` class implements all these interfaces. This `CapabilityManager` handles the terminal capabilities. It is responsible to register/deregister and

get/set capabilities. This design solution allows developers to dynamically handle an unlimited number of capabilities without the burden to manage them directly.

In order for the audio-visual session to respond gracefully to these situations, MPEG-J provides mechanisms for an MPEG-J session object to catch dynamic changes to terminal information and modify its behavior. Upon initialization, an MPEG-J session object may subscribe with the CapabilityManager object to receive notification of changes to dynamic terminal information that is important to that particular audio-visual session. If such information does change during an audio-visual session, the CapabilityManager will notify the MPEG-J session of the change through standardized interfaces. Then the MPEG-J session may respond in the manner prescribed by the content creator. For example, consider an MPEG-J scene representing an MPEG-4 video sequence of a newscaster and a background news clip coded as separate video objects. The content creator might desire to freeze the news clip whenever the actual display frame rate is too slow, rather than sacrificing the quality of the newscaster in the foreground. The content creator can specify this behavior programmatically within the media by subscribing to notifications of frame-rate changes from the terminal. Then, when frame rate drops significantly due, for example, to limited CPU capacity, the media object can dynamically adapt and not continually decode the news clip and further degrade the presentation performance.

On some platforms and scenarios, it may be impossible for the terminal to guarantee the constant availability of all of its resources. For example:

- A wireless multimedia unit may encounter widely varying communication capacities, including intermittent connections.
- A general-purpose computer may experience varying load factors as other processes run on the system.
- Audio-visual sessions with content generated at multiple sources may cause resource contention on the terminal.

Due to the large and increasing number of terminal capabilities all the capability that a terminal support is not defined. The Capability class is used to handle terminal capability in a generic way. Each terminal capability is mapped to a subclass of Capability and then managed by the CapabilityManager class. In this way the CapabilityManager class is able to handle a variable number/type of capabilities without the need to modify/extend it hence to modify the applications that use the CapabilityManager class.

Capability values are not mapped to a specific type such as String but they are handled as generic Java Objects. Through the Java Reflection API (`java.lang.reflect`) every type (possibly added at runtime and not at compile time) can be handled. This facility allows developers to use real types instead of flat types while maintaining the Capability class generic.

11.5.4.3 Terminal Profile Manager

The purpose of the Profile API is to provide a facility that allows applications to find out what is the profile/level supported by the terminal where the application runs. Once an application knows the terminal profile/level it can decide how to behave and what capabilities can operate in the terminal environment. The TerminalProfileManager class allows applications to query the terminal profiles.

11.5.5 Decoder API

The Decoder API facilitate basic control of all the installed decoders in an MPEG session. The decoder associated with a specific node can be queried through the Resource Manager interface. The MPDecoder is an interface that abstracts the most generic decoder.

The MPDecoder APIs allow starting, stopping, pausing, and resuming a decoder. It also facilitates attaching and detaching streams from a decoder using the ESDescriptor. The Descriptor of the currently attached stream can also be obtained.

The decoder attached to a specific node and ESID can be changed with another decoder of the same type. The Resource Manager facilitates getting a list of available decoders of a specific type and also changing one decoder for another, provided they are of the same type.

11.5.6 Net API

The Network APIs intend to allow the control of the network component of the MPEG-4 player. Through these APIs Java applications can interact with network entities. Due to level of abstraction provided by the MPEG-J Network APIs (and, in turn provided by the DMIF interface), the applications can be unaware of the details of the network connections being used (LAN, WAN, Broadcast, local disks, etc.,) to access to a service.

MPEG-J network APIs do not allow full arbitrary usage of the DMIF and Sync Layers to avoid architectural inconsistencies and duplication of tools.

The functionality provided by the current API can be split into two major groups:

Network query. The ability to perform requests to the network module in order to get statistical information about the DMIF resources used by the MPEG-4 player has been recognised as an important feature.

Channels control. A simple channel control mechanism is also provided. Using this feature an MPEG-J application can temporarily disable or enable existing Elementary Stream channels without any negative influence on the rest of the player. This feature fits with one of the general requirements of MPEG-J: the capability to allow graceful degradation under limited or time varying resources.

11.5.7 Section Filter and Service Information APIs

This subclause refers to APIs normatively in the DAVIC 1.4.1 Part 9, specification. These APIs are Section Filtering, Service Information, Resource Notification, and MPEG Component APIs, which are further described in this section. A compliant MPEG-J Terminal apart from implementing the APIs defined in this document shall also implement the APIs referred normatively in this section.

11.5.7.1 The Service Information (SI) API

This API (`org.davic.net.dvb.si`) allows inter-operable applications to access service information data from MPEG-2 streams. One example of such applications would be electronic program guides. This API is a relatively high level API allowing applications to access information from the SI tables in a clean and efficient way. The specification of this API is defined by ETSI DI/ MTA-01074, entitled Application Programming Interface (API) for DAVIC Service Information.

11.5.7.2 The MPEG-2 Section Filter API

The objective of this API (`org.davic.mpeg.sections`) is to provide a general mechanism allowing access to data held in MPEG-2 private sections. This provides a mechanism for inter-operable access to data, which is too specialized to be supported by the high level DVB-SI API or which is not actually related to service information. The definition of the MPEG-2 section filter API is in Annex E of DAVIC 1.4 Part 9 specification. The API definition does not specify the lengths of the section filtering patterns. For those methods which do not specify an offset, the length of the section filtering pattern arrays shall be 8 with their mapping on to the section header as described in the last section of Annex E. For those methods, which include an offset, the length of the section filtering pattern arrays shall be 7. The API definition does not specify the efficiency or effectiveness of the section filtering process. If filtering is happening with filters set beyond the 10th byte of the total section, filtering throughputs must be supported as in DAVIC part 10, section 115.3 with the restriction that support for filtered throughputs of more than 2 Mbits/second is not mandatory.

11.5.7.3 The Resource Notification API

The section filter API uses a resource notification API in the `org.davic.resources` package. This API provides a standard mechanism for applications to register interest in scarce resources and to be notified of changes in those resources or removal of those resources by the environment. The description of this API is in Annex F of DAVIC 1.4 Part 9: 1998 Information Representation.

11.5.7.4 The MPEG Component API

Various MPEG related APIs use an MPEG component API in the `org.davic.mpeg.sections` package. This API provides a standard way of referring to standard MPEG features. The definition of the MPEG component API is in Annex G of DAVIC 1.4 Part 9 specification.

11.5.8 Detailed API Listing

The normative detailed API listing can be found in the Annexes to this document:

Annex U (normative): The HTML files (javadocs) of all the APIs defined in this document along with the necessary images in gif format.

Annex V (normative): Integrated API document (javadocs) of all the html files. This contains the API specification of all the APIs defined in this document.

12 Multiplexing of Elementary Streams

12.1 Introduction

Elementary stream data encapsulated in SL-packetized streams are sent/received through the DMIF Application Interface, as specified in clause 10. Multiplexing procedures and the architecture of the delivery protocol layers are outside the scope of ISO/IEC 14496-1. However, care has been taken to define the sync layer syntax and semantics such that SL-packetized streams can be easily embedded in various transport protocol stacks.

The analysis of existing transport protocol stacks has shown that, for stacks with fixed length packets (e.g., MPEG-2 Transport Stream) or with high multiplexing overhead (e.g., RTP/UDP/IP), it may be advantageous to have a generic, low complexity multiplexing tool that allows interleaving of data with low overhead and low delay. This is particularly important for low bit rate applications. Such a multiplex tool is specified in this clause. Its use is optional.

12.2 FlexMux Tool

12.2.1 Overview

The FlexMux tool is a flexible multiplexer that accommodates interleaving of SL-packetized streams with varying instantaneous bit rate. The basic data entity of the FlexMux is a FlexMux packet, which has a variable length. One or more SL packets are embedded in a FlexMux packet as specified in detail in the remainder of this clause. The FlexMux tool provides identification of SL packets originating from different elementary streams by means of FlexMux Channel numbers. Each SL-packetized stream is mapped into one FlexMux Channel. FlexMux packets with data from different SL-packetized streams can therefore be arbitrarily interleaved. The sequence of FlexMux packets that are interleaved into one stream are called a FlexMux Stream.

A FlexMux Stream retrieved from storage or transmission may be parsed as a single data stream. However, framing of FlexMux packets by the underlying layer is required for random access or error recovery. There is no requirement to frame each individual FlexMux packet. The FlexMux also requires reliable error detection by the underlying layer. This design has been chosen acknowledging the fact that framing and error detection mechanisms are in many cases provided by the transport protocol stack below the FlexMux.

Two different modes of operation of the FlexMux providing different features and complexity are defined. They are called Simple Mode and MuxCode Mode. A FlexMux Stream may contain an arbitrary mixture of FlexMux packets using either Simple Mode or MuxCode Mode. The syntax and semantics of both modes are specified below.

The delivery timing of the FlexMux Stream can be conveyed by means of FlexMux clock reference time stamps. This functionality may be used to establish a multiplex buffer model on the delivery layer. Both the time stamps and the MuxCode Mode require out-of-band configuration prior to usage.

12.2.2 Simple Mode

In the simple mode one SL packet is encapsulated in one FlexMux packet and tagged by an index which is equal to the FlexMux Channel number as indicated in Figure 32. This mode does not require any configuration or maintenance of state by the receiving terminal.

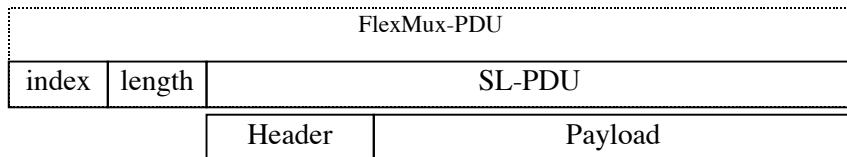


Figure 32 - Structure of FlexMux packet in simple mode

12.2.3 MuxCode mode

In the MuxCode mode one or more SL packets are encapsulated in one FlexMux packet as indicated in Figure 33. This mode requires configuration and maintenance of state by the receiving terminal. The configuration describes how FlexMux packets are shared between multiple SL packets. In this mode the index value is used to dereference configuration information that defines the allocation of the FlexMux packet payload to different FlexMux Channels.

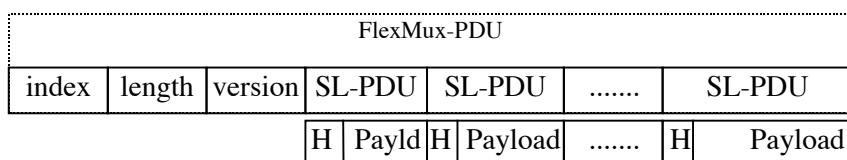


Figure 33 - Structure of FlexMux packet in MuxCode mode

12.2.4 FlexMux packet specification

12.2.4.1 Syntax

```
class FlexMuxPacket (MuxCodeTableEntry mct[], FlexMuxTimingDescriptor FM) {
    unsigned int(8) index;
    bit(8) length;
    if (index<238) {
        SL_Packet sPayload;
    } else if (index == 238) {
        bit(FM.FCR_Length) fmxClockReference;
        bit(FM.fmxRateLength) fmxRate;
    } else if (index == 239) {
        bit(8) stuffing[length];
    } else {
        bit(4) version;
        const bit(4) reserved=0b1111;
        multiple_SL_Packet mPayload(mct[index-240]);
    }
}
```

12.2.4.2 Semantics

The two modes of the FlexMux, Simple Mode and MuxCode Mode as well as special time stamp and stuffing packets are distinguished by the value of index as specified below.

index – if index is smaller than 238 then

FlexMux Channel = index

This range of values corresponds to the Simple Mode.

An index value of 238 indicates a FlexMux packet with clock reference information.

An index value of 239 indicates a FlexMux packet with stuffing.

An `index` value in the range of 240 to 255 (inclusive) indicates that the MuxCode Mode is used and a MuxCode is referenced as

```
MuxCode = index - 240
```

MuxCode is used to associate the payload to FlexMux Channels as described in the Section 12.2.3.

NOTE — Although the number of FlexMux Channels is limited to 256, the use of multiple FlexMux streams allows virtually any number of elementary streams to be provided to the terminal.

`length` – the length of the FlexMux packet payload in bytes. This is equal to the length of the single encapsulated SL packet in Simple Mode and to the total length of the multiple encapsulated SL packets in MuxCode Mode.

`version` – indicates the current version of the `MuxCodeTableEntry` referenced by `MuxCode`. `Version` is used for error resilience purposes. If this version does not match the version of the referenced `MuxCodeTableEntry` that has most recently been received, the FlexMux packet cannot be parsed. The implementation is free to either wait until the required version of `MuxCodeTableEntry` becomes available or to discard the FlexMux packet.

`sPayload` – a single SL packet (Simple Mode).

`mPayload` – one or more SL packets that are identified using the specification of the associated `MuxCodeTableEntry[index-240]` (MuxCode Mode).

`fmxClockReference` – contains a Clock Reference time stamp for the FlexMux stream. The OTB time value `t` is reconstructed from this Clock Reference time stamp according to the following formula:

$$t = (\text{fmxClockReference}/\text{FM.FCRResolution}) + k * (2^{\text{FM.FCRLength}}/\text{FM.FCRResolution})$$

where `k` is the number of times that the `fmxClockReference` counter has wrapped around.

`fmxRate` – is the instant rate at which data from this FlexMux stream is delivered to the associated FlexMux buffers. The rate defined by `fmxRate` applies to all bytes in the FlexMux Clock Reference channel packet and each following FlexMux packet until the occurrence of the next FlexMux Clock Reference channel packet.

`stuffing` – one or more stuffing bytes that shall be discarded by the demultiplexer.

12.2.5 Configuration and usage of MuxCode Mode

12.2.5.1 Syntax

```
aligned(8) class MuxCodeTableEntry {
    int i, k;
    bit(8) length;
    bit(4) MuxCode;
    bit(4) version;
    bit(8) substructureCount;
    for (i=0; i<substructureCount; i++) {
        bit(5) slotCount;
        bit(3) repetitionCount;
        for (k=0; k<slotCount; k++){
            bit(8) flexMuxChannel[[i]][[k]];
            bit(8) numberOfBytes[[i]][[k]];
        }
    }
}
```

12.2.5.2 Semantics

The configuration for MuxCode Mode is signaled by `MuxCodeTableEntry` messages. The transport of the `MuxCodeTableEntry` shall be defined during the design of the transport protocol stack that makes use of the

FlexMux tool. Part 6 of this Final Committee Draft of International Standard defines a method to convey this information using the DN_TransmuxConfig primitive.

The basic requirement for the transport of the configuration information is that data arrives reliably in a timely manner. However, no specific performance bounds are required for this control channel since version numbers allow to detect FlexMux packets that cannot currently be decoded and, hence, trigger suitable action in the receiving terminal.

`length` – the length in bytes of the remainder of the `MuxCodeTableEntry` following the `length` element.

`MuxCode` – the number through which this `MuxCode` table entry is referenced.

`version` – indicates the version of the `MuxCodeTableEntry`. Only the latest received version of a `MuxCodeTableEntry` is valid.

`substructureCount` – the number of substructures of this `MuxCodeTableEntry`.

`slotCount` – the number of slots with data from different FlexMux Channels that are described by this substructure.

`repetitionCount` – indicates how often this substructure is to be repeated. A `repetitionCount` zero indicates that this substructure is to be repeated infinitely. `repetitionCount` zero is only permitted in the last substructure of a `MuxCodeTableEntry`.

`flexMuxChannel[i][k]` – the FlexMux Channel to which the data in this slot belongs.

`numberOfBytes[i][k]` – the number of data bytes in this slot associated to `flexMuxChannel[i][k]`. This number of bytes corresponds to one SL packet.

12.2.5.3 Usage

The `MuxCodeTableEntry` describes how a FlexMux packet is partitioned into slots that carry data from different FlexMux Channels. This is used as a template for parsing FlexMux packets. If a FlexMux packet is longer than the template, parsing shall resume from the beginning of the template. If a FlexMux packet is shorter than the template, the remainder of the template is ignored.

Note that the usage of `MuxCode` mode may not be efficient if SL packets for a given elementary stream do not have a constant length. Given the overhead for an update of the associated `MuxCodeTableEntry`, usage of simple mode might be more efficient.

Note further that data for a single FlexMux channel may be conveyed through an arbitrary sequence of FlexMux packets with both simple mode and `MuxCode` mode.

EXAMPLE —

In this example we assume the presence of three substructures. Each one has a different slot count as well as repetition count. The exact parameters are as follows:

```
substructureCount      = 3
slotCount[i]          = 2, 3, 2 (for the corresponding substructure)
repetitionCount[i]    = 3, 2, 1 (for the corresponding substructure)
```

We further assume that each slot configures channel number `FMC n` (`flexMuxChannel`) with a number of bytes `Bytes n` (`numberOfBytes`). This configuration would result in a splitting of the FlexMux packet payload to:

| | |
|--|------------------------|
| <code>FMC1 (Bytes1), FMC2 (Bytes2)</code> | repeated 3 times, then |
| <code>FMC3 (Bytes3), FMC4 (Bytes4), FMC5 (Bytes5)</code> | repeated 2 times, then |
| <code>FMC6 (Bytes6), FMC7 (Bytes7)</code> | repeated once |

The layout of the corresponding FlexMux packet would be as shown in Figure 34.

| FlexMux-PDU | | | | | | | | | | | | | | | | |
|-----------------------|----------------------------|---------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I n d e x | l e n g t h | v e r s i o n | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| | | | M | M | M | M | M | M | M | M | M | M | M | M | M | M |
| | | | C | C | C | C | C | C | C | C | C | C | C | C | C | C |
| | | | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 3 | 4 | 5 | 6 | 7 |

Figure 34 - Example for a FlexMux packet in MuxCode mode

12.2.6 Configuration and usage of FlexMux clock references

12.2.6.1 Syntax

```
aligned(8) class FlexMuxTimingDescriptor {
    bit(16) FCR_ES_ID;
    bit(32) FCRRResolution;
    bit(8) FCRLength;
    bit(8) FmxRateLength;
}
```

12.2.6.2 Semantics

The sequence of `fmxClockReference` time stamps in a FlexMux stream constitutes a clock reference stream, albeit with a different syntax as specified in clause 10. Elementary streams may be associated to the time base established by this clock reference by referencing the `FCR_ES_ID` as their `OCR_ES_ID` in the `SLConfigDescriptor`. The transport of the `FlexMuxTimingDescriptor` shall be defined during the design of the transport protocol stack that makes use of the FlexMux tool.

`FCR_ES_ID` – is the `ES_ID` associated to this clock reference stream.

`FCRRResolution` – is the resolution of the object time base in cycles per second.

`FCRLength` – is the length of the `fmxClockReference` field in FlexMux packets with `index = 238`. A length of zero shall indicate that no FlexMux packets with `index = 238` are present in this FlexMux stream. `FCRLength` shall take values between zero and 64.

`FmxRateLength` - is the length of the `fmxRate` field in FlexMux packets with `index = 238`. `FmxRateLength` shall take values between 1 and 32.

12.2.6.3 Usage

The FlexMux clock reference time stamps may be used to establish and verify a multiplex buffer model. The `fmxClockReference` information determines the arrival time $t(i)$ of individual bytes i of the FlexMux stream in the following way:

$$t(i) = \frac{FCR(i'')}{FCR Resolution} + \frac{i - i''}{fmxRate(i)}$$

where:

i is the index of any byte in the FlexMux stream for $i'' < i < i'$

i'' is the index of the byte containing the last bit of the most recent `fmxClockReference` field in the FlexMux stream

`FCR(i")` is the time encoded in the `fmxClockReference` in units of `FCRResolution`

`fmxRate(i)` indicates the rate specified by the `fmxRate` field for byte `i`

12.2.7 FlexMux buffer descriptor

12.2.7.1 Syntax

```
aligned(8) class FlexMuxBufferDescriptor {
    bit(8) flexMuxChannel;
    bit(24) FB_BufferSize;
}
```

12.2.7.2 Semantics

The size of multiplex buffers for each FlexMux channel is signaled by `FlexMuxBufferDescriptors`. One descriptor per FlexMux channel is required unless the `DefaultFlexMuxBufferDescriptor` is used. The transport of the `FlexMuxBufferDescriptors` shall be defined during the design of the transport protocol stack that makes use of the FlexMux tool.

`flexMuxChannel` - the number of a FlexMux channel.

`FB_BufferSize` - the size of the FlexMux buffer for this FlexMux channel in bytes.

12.2.8 Default FlexMux buffer descriptor

12.2.8.1 Syntax

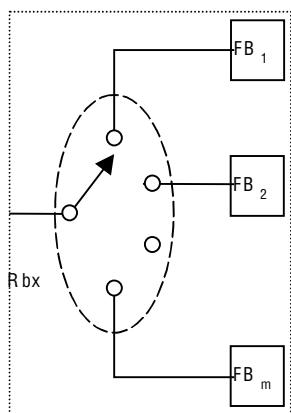
```
aligned(8) class DefaultFlexMuxBufferDescriptor {
    bit(24) FB_DefaultBufferSize;
}
```

12.2.8.2 Semantics

The default size of multiplex buffers for each individual channel in a FlexMux stream is signaled by the `DefaultFlexMuxBufferDescriptor`. FlexMux channels that use a different buffer size may signal this using the `FlexMuxBufferDescriptor`. The transport of the `DefaultFlexMuxBufferDescriptor` shall be defined during the design of the transport protocol stack that makes use of the FlexMux tool.

`FB_DefaultBufferSize` - the default size of FlexMux buffers for this FlexMux stream in bytes.

12.2.9 FlexMux buffer model



FB_n is the FlexMux buffer for the elementary stream in FlexMux channel n
 R_{bx} is the rate at which data enters the FlexMux buffers.

The FlexMux buffer model applies to FlexMux streams that utilize FlexMux Clock reference channel packets to define the delivery timing of the FlexMux stream. The FlexMux stream enters the FlexMux buffer model at the rate and timing as defined by the fmxClockReference and fmxRate fields. There may be some periods of time during which there are no bytes at the input of the FlexMux buffer model, but the bytes of all FlexMux packets that precede the next FlexMux Clock reference channel packet shall be delivered to the FlexMux buffer model prior to the delivery of any byte of the next FlexMux Clock reference channel packet.

For each FlexMux channel i the FlexMux packet is stored in FlexMux Buffer FB_i . The bytes in buffer FB_i are removed at a rate specified by the InstantRate field in the SL header of the contained SL-packetized stream. Upon removal each byte enters the elementary stream buffer DB_i . The FlexMux stream shall be constructed so that the following condition is met :

- Buffer FB_i shall not overflow.

13 File Format

13.1 Introduction

The MP4 file format is designed to contain the media information of an ISO/IEC 14496 presentation in a flexible, extensible format that facilitates interchange, management, editing, and presentation of the media. This presentation may be ‘local’ to the system containing the presentation, or may be via a network or other stream delivery mechanism (a TransMux).

The file format is designed to be independent of any particular TransMux while enabling efficient support for TransMuxes in general.

13.1.1 Usage

The file format is intended to serve as a basis for a number of operations. In these various roles, it may be used in different ways, and different aspects of the overall design exercised.

13.1.1.1 Interchange

When used as an interchange format, the files would normally be self-contained (not referencing media in other files), contain only the media data actually used in the presentation, and not contain any information related to streaming over TransMuxes. This will result in a small, protocol-independent, self-contained file, which contains the core media data and the information needed to operate on it.

The following diagram gives an example of a simple interchange file, containing three streams.

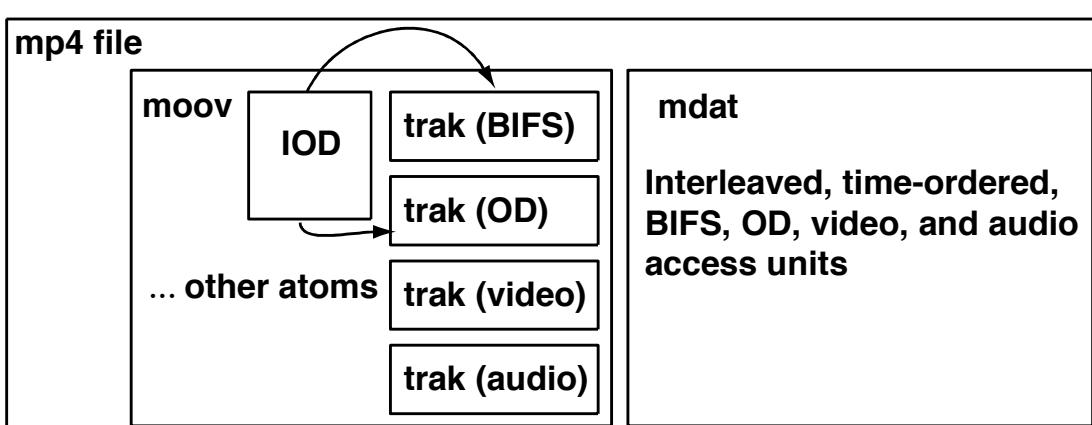


Figure 35 - Simple interchange file

13.1.1.2 Content Creation

During content creation, a number of areas of the format can be exercised to useful effect, particularly:

- the ability to store each elementary stream separately (not interleaved), possibly in separate files.
- the ability to work in a single presentation which contains MPEG-4 data and other streams (e.g. editing the audio track in the uncompressed format, to align with an already-prepared MPEG-4 video track).

These characteristics mean that presentations may be prepared, edits applied, and content developed and integrated without either iteratively re-writing the presentation on disc - which would be necessary if interleave was required and unused data had to be deleted; and also without iteratively decoding and re-encoding the data - which would be necessary if the data must be stored in an encoded state.

In the following diagram, a set of files being used in the process of content creation is shown.

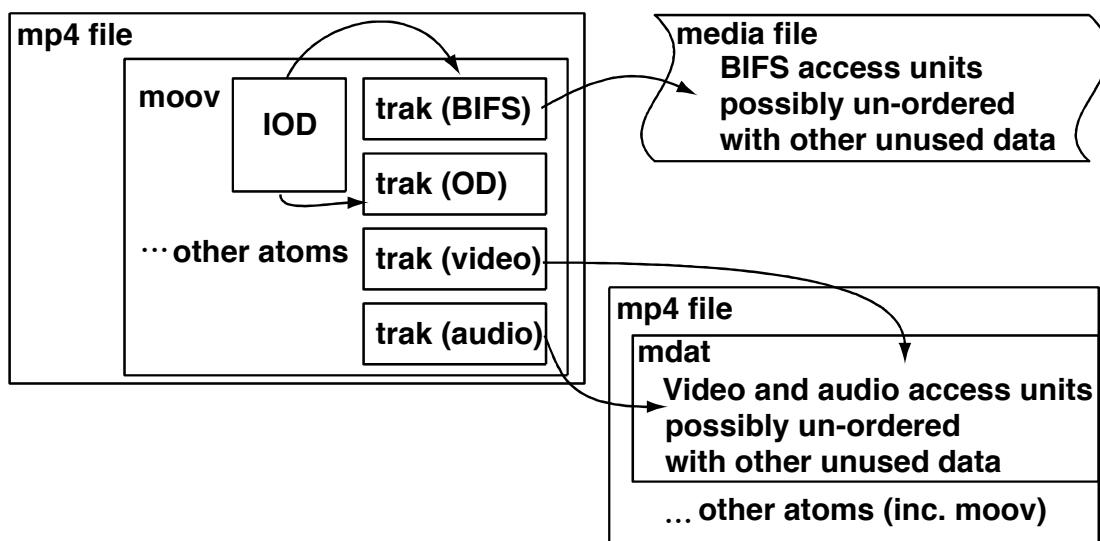


Figure 36 - Content Creation MP4 File

13.1.1.3 Preparation for streaming

When prepared for streaming, the file must contain information to direct the streaming server in the process of sending the information. In addition, it is helpful if these instructions and the media data are interleaved so that excessive seeking can be avoided when serving the presentation. It is also important that the original media data be retained unscathed, so that the files may be verified, or re-edited or otherwise re-used. Finally, it is helpful if a single file can be prepared for more than one protocol, so differing servers may use it over disparate protocols.

13.1.1.4 Local presentation

'Locally' viewing a presentation (i.e. directly from the file, not over a streamed interconnect) is an important application; it is used when a presentation is distributed (e.g. on CD or DVD ROM), during the process of development, and when verifying the content on streaming servers. Such local viewing must be supported, with full random access. If the presentation is on CD or DVD ROM, interleave is important as seeking may be slow.

13.1.1.5 Streamed presentation

When a server operates from the file to make a stream, the resulting stream must be conformant with the specifications for the protocol(s) used, and should contain no trace of the file-format information in the file itself. The server needs to be able to random access the presentation. It can be useful to re-use server content (e.g. to make excerpts) by referencing the same media data from multiple presentations; it can also assist streaming if the media data can be on read-only media (e.g. CD) and not copied, merely augmented, when prepared for streaming.

The following diagram shows a presentation prepared for streaming over a multiplexing protocol, only one hint track is required.

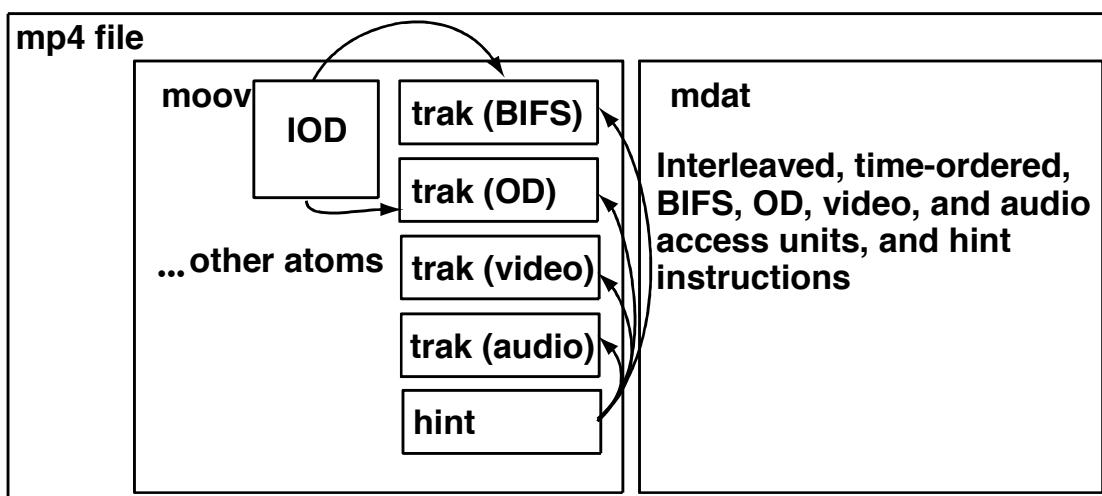


Figure 37 - Hinted Presentation for Streaming

13.1.2 Design principles

The file structure is object-oriented; a file can be decomposed into constituent objects very simply, and the structure of the objects inferred directly from their type.

Media-data is not ‘framed’ by the file format; the file format declarations which give the size, type and position of media data units is not physically contiguous with the media data. This makes it possible to subset the media-data, and to use it in its natural state, without requiring it to be copied to make space for framing. The meta-data is used to describe the media data by reference, not by inclusion.

Similarly the protocol information for a particular TransMux does not frame the media data; the protocol headers are not physically contiguous with the media data. Instead, the media data is included by reference. This makes it possible to represent media data in its natural state, not favoring any TransMux. It also makes it possible for the same set of media data to serve for local presentation, and for multiple TransMuxes.

The protocol information is built in such a way that the streaming servers need to know only about the protocol and the way it should be sent; the protocol information abstracts knowledge of the media so that the servers are, to a large extent, media-type agnostic. Similarly the media-data, stored as it is in a protocol-unaware fashion, enables the media tools to be protocol-agnostic.

The file format does not require that a single presentation be in a single file. This enables both sub-setting and re-use of content. When combined with the non-framing approach, it also makes it possible to include media data in files not formatted to this specification (e.g. ‘raw’ files containing only media data and no declarative information, or file formats already in use in the media or computer industries).

The file format is based on a common set of designs and a rich set of possible structures and usage. The same format serves all usages; translation is not required. However, when used in a particular way (e.g. for local presentation), profiles may be used to define the optimal structures and use of options for that usage. However, there is no provision for profiles or levels in the current specification.

13.1.3 Design overview

13.1.3.1 Storage of elementary streams

To maintain the goals of TransMux independence, the media data is stored in its most ‘natural’ format, and not fragmented. This enables easy local manipulation of the media data. Therefore media-data is stored as access units, a range of contiguous bytes for each access unit.

13.1.3.2 Handling of elementary streams

The elementary streams in an MPEG-4 presentation are stored in the media tracks as access units (a single access unit is the definition of a ‘sample’ for an MPEG-4 media stream). This is true for all stream types in this draft, including such ‘meta-information’ streams as Object Descriptor and the Clock Reference. The consequences of this are, on the positive side, that the file format treats all streams equally; on the negative side, this means that there are ‘internal’ cross-links between the streams. This means that adding and removing streams from a presentation will involve more than adding or deleting the track and its associated media-data. Not only must the stream be placed in, or removed from, the scene, but also the object descriptor stream may need updating.

In a transmitted bit-stream, the access units in the SL Packets are transmitted on byte boundaries. This means that hint tracks will construct SL Packet headers using the information in the media tracks, and the hint tracks will reference the access units from the media track.

The SLConfigDescriptor for the media track shall be stored in the file using a default value (predefined = 2), except when the Elementary Stream Descriptor refers to a stream through a URL, i.e. the referred stream is outside the scope of the MP4 file. In that case the SLConfigDescriptor is not constrained to this predefined value.

13.1.3.3 Handling of FlexMux

An intermediate, optional, fragmentation and packetization step, called FlexMux, has been defined in this document. Some TransMuxes may carry a FlexMux stream rather than packetized elementary streams. Flexmux may be employed for a variety of purposes, including, but not limited to:

- reducing wasted network bandwidth caused by SL Packet header overhead when the payload is small;
- reducing required server resources when providing many streams, by reducing the number of disk reads or network writes.

The process of building FlexMux PDUs is necessarily aware of the characteristics of the TransMux into which the FlexMux must be placed. It is not therefore possible to design a TransMux-independent handling of FlexMux. Instead, in those TransMuxes where FlexMux is used, the hint tracks for that TransMux will encapsulate and include the formation of FlexMux packets. It is expected that the design of the hint tracks (as defined in Section 13.2.2.2) will, in this case, closely reflect the way that FlexMux is used. For example, a compact table resembling the MuxCode (a method used to associate the payload to FlexMux Channels) mode may be needed if the interleave offered by that mode is needed.

Note that in some cases, it may not be possible to create a static FlexMux multiplex via a hint track. Notably, if stream selection is dynamic (for example, based on application feedback) or the choice of muxcode modes or other aspects of Flexmux is dynamic, the FlexMux is therefore created dynamically. This is a necessary cost of run-time multiplexing. It may be difficult for a server to create such a multiplex dynamically at runtime, but with this cost comes added flexibility. A server that wished to provide such functionality could weigh the costs and benefits, and choose to perform the multiplexing without the aid of hint tracks.

Several ISO/IEC 14496 structures are intrinsically linked to FlexMux, and therefore must be addressed in the context of a FlexMux-aware hint track. For example, a stream map table must be supplied to the receiving terminal which maps FlexMux channel IDs to elementary stream IDs. Similarly, if the MuxCode mode of FlexMux is used, a MuxCode mode structure for each MuxCode index used must be defined and supplied to the terminal.

These mappings and definitions may change over time, and there is no normative way in ISO/IEC 14496 to supply these to the terminals; instead, some mechanism, associated with the overall system design or TransMux used, must be employed. The hinter must store the mappings and definitions. Because they are intimately associated with a particular time-segment of a particular hint track, it is recommended that they be placed in the sample description(s) for that hint track. This description would normally be in the form of:

- a table mapping FlexMux channels to elementary stream IDs.
- a set of MuxCode mode structure definitions.

It is recommended further that a format such as that in section 12.2.5, be used for the MuxCode mode definitions.

```
aligned(8) class MuxCodeTableEntry {
    int    i, k;
```

```

bit(8) length;
bit(4) MuxCode;
bit(4) version;
bit(8) substructureCount;
for (i=0; i<substructureCount; i++) {
    bit(5) slotCount;
    bit(3) repetitionCount;
    for (k=0; k<slotCount; k++){
        bit(8) flexMuxChannel[[i]][[k]];
        bit(8) numberOfBytes[[i]][[k]];
    }
}
}

```

Special attention must also be taken when pausing or seeking a stream that is being transported as part of a FlexMux stream. Pausing or seeking any component stream of a FlexMux must necessarily pause or seek all the streams. When seeking, care must be taken with random access points. These may not be aligned in time in the streams which form the FlexMux, which means that any seek operation cannot start them all at a random access point. Indeed, the random access points of the FlexMux itself are necessarily rather poorly defined under such circumstances.

It may be necessary for the server to:

- examine the track references to determine the base media tracks (elementary streams) which are formed into the FlexMux;
- find the latest time before the desired seek point such that there is a random access point for all the streams between that time and the seek point, by examining each stream separately;
- transmit the FlexMux stream from that time.

This will ensure that the terminal has received a random access point for all streams at or prior to the desired seek time. However, it may have to discard data for those streams which had data received before the random access points.

13.1.3.4 Handling of TransMuxes

The file format supports streaming of media data over a network as well as local playback. The process of sending protocol data units is time-based, just like the display of time-based data, and is therefore suitably described by a time-based format. A file or ‘movie’ that supports streaming includes information about the data units to stream. This information is included in additional tracks of the file called “hint” tracks.

Hint tracks contain instructions to assist a streaming server in the formation of packets for transmission. These instructions may contain immediate data for the server to send (e.g. header information) or reference segments of the media data. These instructions are encoded in the file in the same way that editing or presentation information is encoded in a file for local playback. Instead of editing or presentation information, information is provided which allows a server to packetize the media data in a manner suitable for streaming using a specific network transport or TransMux.

The same media data is used in a file that contains hints, whether it is for local playback, or streaming over a number of different TransMuxes. Separate ‘hint’ tracks for different TransMuxes may be included within the same file and the media will play over all such TransMuxes without making any additional copies of the media itself. In addition, existing media can be easily made streamable by the addition of appropriate hint tracks for specific TransMuxes. The media data itself need not be recast or reformatted in any way.

This approach to streaming is more space efficient than an approach that requires that the media information be partitioned into the actual data units which will be transmitted for a given transport and media format. Under such an approach, local playback requires either re-assembling the media from the packets, or having two copies of the media—one for local playback and one for streaming. Similarly, streaming such media over multiple TransMuxes using this approach requires multiple copies of the media data for each transport. This is inefficient with space, unless the media data has been heavily transformed for streaming (e.g., by the application of error-correcting coding techniques, or by encryption).

13.1.3.5 TransMux ‘hint’ tracks

Support for streaming is based upon the following three design parameters:

- The media data is represented as a set of network-independent standard tracks, which may be played, edited, and so on, as normal;
- There is a common declaration and base structure for server hint tracks; this common format is protocol independent, but contains the declarations of which protocol(s) are described in the server track(s);
- There is a specific design of the server hint tracks for each TransMux that may be transmitted; all these designs use the same basic structure. For example, there may be designs for RTP (for the Internet) and MPEG-2 transport (for broadcast), or for new standard or vendor-specific protocols.

The resulting streams, sent by the servers under the direction of the hint tracks, need contain no trace of file-specific information. This design does not require that the file structures or declaration style, be used either in the data on the wire or in the decoding station. For example, a file using H.261 video and DVI audio, streamed under RTP, results in a packet stream which is fully compliant with the IETF specifications for packing those codings into RTP.

The hint tracks are built and flagged so that when the presentation is viewed directly (not streamed), they may be ignored.

The specific design of the media data (hint samples), and sample descriptions for a particular TransMux is not defined by this part of ISO/IEC 14496. Instead, the designer of the system using that TransMux, or the body that owns and defines the TransMux, would define these tracks. Clearly there is an advantage in having standard hint track formats for standard TransMuxes, and their development and publication is encouraged.

13.2 File organization

13.2.1 Presentation structure

13.2.1.1 File Structure

A presentation may be contained in several files. One file contains the meta-data for the whole presentation, and is formatted to this specification. This file may also contain all the media data, whereupon the presentation is self-contained. The other files, if used, do not have to be formatted to this specification; they can contain used or unused media data, or other information. This specification concerns the structure of the presentation file only. The format of the media-data files is constrained by this specification only in that the media-data in the media files must be able to be described by the meta-data defined here.

If a MP4 file contains hint tracks, the media tracks which reference the media data from which the hints were built must remain in the file, even if the data within them is not directly referenced by the hint tracks.

13.2.1.2 Object Structure

The file is structured as a sequence of objects; some of these objects may contain other objects. The sequence of objects in the file must contain exactly one presentation meta-data wrapper (the movie atom). It is usually at the beginning or end of the file, to permit its easy location. The other objects that are found at this level may be free space, or media data atoms.

The fields in the objects are stored in network byte order (big-endian format).

13.2.1.3 Meta Data and Media Data

The meta-data is contained within the meta-data wrapper (the movie atom); the media data is contained either in the same file, within media-data atom(s), or in other files. The media data is composed of access units; the media data objects, or media data files, may contain other unreferenced information.

13.2.1.4 Track Identifiers

The track identifiers used in an MP4 file are unique within that file; no two tracks may use the same identifier.

Each elementary stream in the file is stored as a media track. The lower two bytes are the elementary stream identifier (ES_ID). The upper two bytes are zero. Hint tracks may use track identifier values in the same range, if this number space is adequate (which it generally is). However, hint track identifiers may also use larger values of track identifier, as their identifiers are not mapped to elementary stream identifiers. Thus very large presentations can use the entire 16-bit number space for elementary stream identifiers.

The next track identifier value in the movie header generally contains a value one greater than the largest track identifier value found in the file. This enables easy generation of a track identifier under most circumstances. However, if this value is equal to or larger than 65535, and a new media track is to be added, then a search must be made in the file for a free track identifier. If the value is all 1s (32-bit maxint) then this search is needed for all additions.

If it is desired to add a track with a known track identifier (elementary stream identifier) then the file must be searched to ensure that there is no conflict. Note that hint tracks can be re-numbered fairly easily while more care should be taken with media tracks, as there may be references to their ES_ID (track ID) in other tracks.

Note that if it is desired to have hint tracks have track IDs outside the allowed range for elementary stream tracks, then next track ID will document the next available hint track ID. Since this is larger than 65535, a search will then always be needed to find a valid elementary stream track ID.

If two presentations are merged, then there may be conflict between their track IDs. In that case, one or more tracks will have to be re-numbered. There are two actions to be taken here:

- Changing the ID of the track itself, which is easy (track ID in the track header).
- Changing pointers to it.

The pointers may only occur in the file format structure itself. The file format uses track IDs only through track references, which are easily found and modified. Track IDs become ES_IDs in the MPEG-4 data, and ES_IDs occur within the OD Stream. Since all pointers to ES_IDs in the OD stream are replaced by means of track references there is no need to inspect the OD stream for cross-references within MPEG-4 streams.

Note that in ES_DescriptorRemove and IPI_DescrPointer it is a track reference *index* (using references of type mpod and ipir respectively – see subclause 13.2.3.7.2) that is stored in the file, and the tag values are specific to the file format (ES_DescriptorRemoveRefTag and IPI_DescrPointerRefTag). These reference indexes should be replaced with the ES_ID when hinting or serving, and the tag values adjusted.

13.2.1.5 Synchronization of streams

In the absence of explicit declarations to the contrary, tracks (streams) coming from the same file should be presented synchronized. This means that hinters and/or servers should either pick one of the streams to serve as the OCR source for the others or add an OCR stream to associate all the streams with it. Track references of type 'sync' can be used in the file to defeat the default behavior. In MPEG-4 the OCRStreamFlag and OCR_ES_ID fields in the ESDescriptor govern the synchronization relationships. The mapping of MP4 structures into those fields shall obey the following rules:

- The MPEG-4 ESDescriptor, as stored in the file, usually contains OCRStreamFlag set to FALSE, and no OCR_ES_ID. If an OCR_ES_ID is set, it should be used as is without interpretation or inspection; this case is normally used to synchronize to streams outside the file.
- If a track (stream) contains a track reference of type 'sync' whose value is 0, then the hinter or server shall set the OCRStreamFlag field in the MPEG-4 ESDescriptor to FALSE and shall not insert any OCR_ES_ID field. This means that this stream is not synchronized to another, but other streams can be synchronized to it.
- If a track (stream) contains a track reference of type 'sync' whose value is not 0, then the hinter or server shall set the OCRStreamFlag field in the MPEG-4 ESDescriptor to TRUE and shall insert an OCR_ES_ID field with the same value contained in the 'sync' track reference. This means that this stream is synchronized to the stream indicated in the OCR_ES_ID. Note that other streams may also be synchronized to the same stream, either explicitly or implicitly.
- If a track (stream) does not contain a track reference of type 'sync', then the default behavior applies. The hinter or server shall set the OCRStreamFlag field in the MPEG-4 ESDescriptor to TRUE and shall insert an

OCR_ES_ID field with a value selected based on the rules below. This means that this stream is synchronized to the stream indicated in the OCR_ES_ID. The rules for selecting the OCR_ES_ID are as follows:

- if no track (stream) in the file contains a track reference of type 'sync', then the hinter picks one trackId and uses that value for the OCR_ES_ID field of all ESDescriptors. There is one possible exception where the ESDescriptor of the stream which corresponds to that trackId, for which the OCRStreamFlag may be set to FALSE.
- if one or more tracks (streams) in the file contain a track reference of type 'sync', and all such track references indicate consistently a single trackId, then the hinter uses that trackId. Note that in a track reference of type 'sync' the value 0 is equivalent to the trackId of the track itself.
- if two or more tracks (streams) in the file contain a track reference of type 'sync', and such track references do not indicate a single trackId, then the hinter cannot make a deterministic selection and the behavior is undefined. Note again that in a track reference of type 'sync' the value 0 is equivalent to the trackId of the track itself.

13.2.2 Media Data Structure

13.2.2.1 Elementary Stream Tracks

In the file format, the media data is stored as access units; for each track the entire ES-descriptor is stored as the sample description or descriptions. The SLConfigDescriptor is stored according to a default value (predefined = 2) except when the ES-descriptor contains a URL to point to an elementary stream outside the scope of the MP4 file.

Note that the SL Packet header and payload are byte-aligned, so the placement of the header during hinting is possible without bit shifting, as each SL Packet and corresponding contained access unit will both start on byte boundaries.

Note also that an access unit must be stored as a contiguous set of bytes. This greatly facilitates the fragmentation process used in hint tracks. The file format can describe and use media data stored in other files, however this restriction still applies. Therefore if a file is to be used which contains 'pre-fragmented' media data (e.g. a FlexMux stream on disc), the media data will need to be copied to re-form the access units, in order to import the data into this file format.

The ESDescriptor for a stream within the scope of the MP4 file as described in this document is stored in the sample description and the fields and included structures are restricted as follows:

- **ES_ID** - set to 0 as stored; when built into a TransMux, the lower 16 bits of the trackID is used.
- **streamDependenceFlag** – set to 0 as stored; instead, track references of type 'dpnd' are used.
- **URLflag** – set to false, as the stream is in the file, not remote.
- **SLConfigDescriptor** - is predefined type 2.
- **OCRStreamFlag** – set to false in the file.

Note that the QoSDescriptor also may need re-writing for transmission as it contains information about PDU sizes etc.

13.2.2.1.1 Object Descriptors

The initial object descriptor and object descriptor streams are handled specially within the file format. Object descriptors contain ES descriptors, which in turn contain TransMux specific information. In addition, to facilitate editing, the information about a track is stored as an ESDescriptor in the sample description within that track. It must be taken from there, re-written as appropriate, and transmitted as part of the OD stream when the presentation is streamed.

As a consequence, ES descriptors are not stored within the OD track or initial object descriptor. Instead, the initial object descriptor has a descriptor used only in the file, containing solely the track ID of the elementary stream. When used, an appropriately re-written ESDescriptor from the referenced track replaces this descriptor. Likewise, OD tracks are linked to ES tracks by track references. Where an ES descriptor would be used within the OD track,

another descriptor is used, which again occurs only in the file. It contains the index into the set of mpod track references that this OD track owns. A suitably re-written ESDescriptor replaces it by the hinting of this track.

The ES_ID_Inc is used in the initial object descriptor atom:

```
class ES_ID_Inc extends BaseDescriptor : bit(8) tag=ES_IDIncTag {
    unsigned int(32) Track_ID; // ID of the track to use
}
```

ES_ID_IncTag = 0x0E is reserved for file format usage.

The ES_ID_Ref is used in the OD stream:

```
class ES_ID_Ref extends BaseDescriptor : bit(8) tag=ES_IDRefTag {
    bit(16) ref_index; // track ref. index of the track to use
}
```

ES_ID_RefTag = 0x0F is reserved for file format usage.

MP4_IOD_Tag = 0x10 is reserved for file format usage.

MP4_OD_Tag = 0x11 is reserved for file format usage.

IPL_DescrPointerRefTag = 0x12 is reserved for file format usage.

ES_DescrRemoveRefTag = 0x07 is reserved for file format usage (command tag).

NOTE - The above tag values are defined in subclause 8.2.2.2 Table 1 and subclause 8.2.3.2 Table 2, and the actual values should be referenced from those tables.

A hinter may need to send more OD events than actually occur in the OD track: for example, if the ES_description changes at a time when there is no event in the OD track. In general, any OD events explicitly authored into the OD track should be sent along with those necessary to indicate other changes. The ES descriptor sent in the OD track would be taken from the description of the temporally next sample in the ES track (in decoding time).

13.2.2.2 Hint Tracks

Hint tracks are used to describe to a server how to serve the elementary stream data in the file over TransMuxes. Each TransMux has its own hint track format. The format of the hints is described by the sample description for the hint track. Most TransMuxes will need only one sample description format for each track.

Servers find their hint tracks by first finding all hint tracks, and then looking within that set for hint tracks using their protocol (sample description format). If there are choices at this point, then the server chooses on the basis of preferred protocol or by comparing features in the hint track header or other protocol-specific information in the sample descriptions.

Hint tracks construct TransMuxes by pulling data out of other tracks by reference. These other tracks may be hint tracks or elementary stream tracks. The exact form of these pointers is defined by the sample format for the protocol, but in general they consist of four pieces of information: a track reference index, a sample number, an offset, and a length. Some of these may be implicit for a particular protocol. Note that these ‘pointers’ always point to the actual source of the data. If a hint track is built ‘on top’ of another hint track, then the second hint track will have direct references to the media track(s) used by the first where data from those media tracks is placed in the TransMux.

All hint tracks use a common set of declarations and structures.

- Hint tracks are linked to the elementary stream tracks they carry, by track references of type ‘hint’
- They use a handler-type of ‘hint’ in the handler reference atom
- They use a hint media header atom
- They use a hint sample entry in the sample description, with a name and format unique to the protocol they represent.

Hint tracks may be created by an authoring tool, or may be added to an existing presentation by a hinting tool. Such a tool serves as a ‘bridge’ between MPEG-4 and the protocol, since it intimately understands both. This permits authoring tools to understand MPEG-4, but not protocols, and for servers to understand protocols (and their hint tracks) but not the details of MPEG-4 data.

13.2.3 Meta-data Structure (Objects)

The following represents the subset of the QuickTime file specification that is required to define an MP4 file. An object in QuickTime terminology is an Atom. Atoms not explicitly defined in this standard may be ignored.

Atoms start with a header that gives both size and type. The header permits compact or extended size (32 or 64 bits unsigned integer) giving the size of the object in bytes and compact or extended types (32 bits unsigned integer or full UUIDs). The standard MPEG-4 atoms all use compact types (32-bit) normally interpreted and presented as four printable characters, for ease of identification. Most atoms will use the compact (32-bit) size. Typically only the media data atom(s) may need the 64-bit size.

Note that the size is the entire size of the atom, including the size and type header, fields, and all contained atoms. This facilitates simplified parsing of the file. A zero size field, allowed only at the top-level atoms, indicates that the last atom in the file which extends to the end of the file. This is normally only used for media data (mdat) atoms. Note also that all indexes start with the value one rather than zero.

```
aligned(8) class Atom (unsigned int(32) atomtype,
    optional unsigned int(8)[16] extended-type) {
    unsigned int(32) size;
    unsigned int(32) type = atomtype;
    if (size==1) {
        unsigned int(64) largesize;
    }
    if (atomtype=='uuid') {
        unsigned int(8)[16] usertype = extended-type;
    }
}
```

The semantics of these two fields are:

size - is an integer that specifies the number of bytes in this atom including all its fields and contained atoms; if size is set to 1 then the actual size is given by the large size field.

type - identifies the atom type. Standard atoms use a compact type that is normally four printable characters to permit ease of identification, and this is shown in the atoms below. User extensions use an extended type. In this case the type field is set to 'uuid'.

Type fields not defined here are reserved. Private extensions shall be achieved through the 'uuid' type. The following types are reserved and will either not be used or will be used only in their existing sense in future versions of this specification to avoid conflict with existing content using earlier pre-standard versions of this format:

```
clip, crgn, matt, kmat, pnot, ctab, load, imap; track reference types tmcd, chap,
scpt, ssrc.
```

Many objects also contain a version number and flags field:

```
aligned(8) class FullAtom(unsigned int(32) atomtype, unsigned int(8) v, bit(24) f)
    extends Atom(atomtype) {
    unsigned int(8) version = v;
    bit(24) flags = f;
}
```

The semantics of these two fields are:

version - is an integer that specifies the version of this format of the atom.

flags - is a map of flags.

In a number of atoms in this specification, there are two variant forms: version 0 using 32-bit fields, and version 1 using 64-bit sizes for those same fields. In general, if a version 0 atom (32-bit field sizes) can be used, it should be; version 1 atoms should be used only when the 64-bit field sizes they permit, are required.

For convenience during content creation there are creation and modification times stored in the file. These can be 32-bit or 64-bit numbers, counting seconds since midnight, Jan. 1, 1904, which is a convenient date for leap-year calculations. 32 bits are sufficient until approximately year 2040.

Fields shown as reserved in the atom descriptions should be initialized to the given value on atom creation, copied un-inspected when atoms are copied, and ignored on reading.

An overall view of the normal encapsulation structure is provided in the following table.

The table shows atoms that may occur at the top-level in the left-most column; indentation is used to show possible containment. Thus, for example, a track header (tkhd) is found in a track (trak), which is found in a movie (moov). Not all atoms need be used in all files; the mandatory atoms are marked with an asterisk (*). See the description of the individual atoms for a discussion of what must be assumed if the optional atoms are not present.

Note that user data objects may be found in moov or trak atoms, and objects using an extended type may be placed in a wide variety of containers, not just the top level.

Table 55 - Overview of Atom Encapsulation Structure

| | | | | | | | |
|------|------|------|--------|------|---|-------------|---|
| Moov | | | | | * | 13.2.3.1 | <i>container for all the meta-data</i> |
| | mvhd | | | | * | 13.2.3.3 | <i>movie header, overall declarations</i> |
| | iods | | | | * | 13.2.3.4 | <i>object descriptor</i> |
| | trak | | | | * | 13.2.3.4.2 | <i>container for an individual track or stream</i> |
| | | tkhd | | | * | 13.2.3.6 | <i>track header, overall information about the track</i> |
| | | tref | | | | 13.2.3.7 | <i>track reference container</i> |
| | | edts | | | | 13.2.3.25 | <i>edit list container</i> |
| | | elst | | | | 13.2.3.26 | <i>an edit list</i> |
| | | mdia | | | * | 13.2.3.8 | <i>container for the media information in a track</i> |
| | | mdhd | | | * | 13.2.3.9 | <i>media header, overall information about the media</i> |
| | | hdlr | | | | 13.2.3.10 | <i>handler, at this level, the media (handler) type</i> |
| | | minf | | | * | 13.2.3.11 | <i>media information container</i> |
| | | | vmhd | | | 13.2.3.12.1 | <i>video media header, overall information (video track only)</i> |
| | | | smhd | | | 13.2.3.12.2 | <i>sound media header, overall information (sound track only)</i> |
| | | | hmhd | | | 13.2.3.12.3 | <i>hint media header, overall information (hint track only)</i> |
| | | | <mpeg> | | | 13.2.3.12.4 | <i>mpeg stream headers</i> |
| | | | dinf | | * | 13.2.3.13 | <i>data information atom, container</i> |
| | | | | dref | * | 13.2.3.14 | <i>data reference atom, declares source(s) of media in track</i> |
| | | | stbl | | * | 13.2.3.15 | <i>sample table atom, container for the time/space map</i> |
| | | | | stts | * | 13.2.3.16.1 | <i>(decoding) time-to-sample</i> |
| | | | | ctts | | 13.2.3.16.2 | <i>composition time-to-sample table</i> |
| | | | | stss | | 13.2.3.21 | <i>sync (key, I-frame) sample map</i> |
| | | | | stsd | * | 13.2.3.17 | <i>sample descriptions (codec types, initialization etc.)</i> |
| | | | | stsz | * | 13.2.3.18 | <i>sample sizes (framing)</i> |
| | | | | stsc | | 13.2.3.19 | <i>sample-to-chunk, partial data-offset information</i> |
| | | | | stco | | 13.2.3.20 | <i>chunk offset, partial data-offset information</i> |
| | | | | stsh | | 13.2.3.22 | <i>shadow sync</i> |
| | | | | stdp | | 13.2.3.23 | <i>degradation priority</i> |
| mdat | | | | | | 13.2.3.2 | <i>Media data container</i> |
| free | | | | | | 13.2.3.24 | <i>free space</i> |
| skip | | | | | | 13.2.3.24 | <i>free space</i> |
| udta | | | | | | 13.2.3.27 | <i>user-data, copyright etc.</i> |

13.2.3.1 Movie Atom

Atom Type: 'moov'

Container: File

Mandatory: Yes

Quantity: Exactly one

The meta-data for a presentation is stored in the single Movie Atom that occurs at the top-level of a file. Normally this atom is the first or last in the sequence of atoms in a file, though this is not required.

13.2.3.1.1 Syntax

```
aligned(8) class MovieAtom extends Atom('moov') {
}
```

13.2.3.2 Media Data Atom

Atom Type: 'mdat'
 Container: File
 Mandatory: No
 Quantity: Any number

This atom contains the media data. In elementary stream tracks, this atom will contain MPEG-4 data as access units. A presentation may contain zero or more media data atoms. The actual media data follows the type field; its structure is described by the meta-data (see particularly the sample table).

In large presentations, it may be desirable to have more data in this atom than a 32-bit size would permit. In this case, the large variant of the size field, above, is used.

NOTE - there may be any number of these atoms in the file (including zero, if all the media data is in other files). The meta-data refers to media data by its absolute offset within the file (see the chunk offset atom); so mdat headers and free space may easily be skipped, and files without any atom structure may also be referenced and used.

13.2.3.2.1.1 Syntax

```
aligned(8) class MediaDataAtom extends Atom('mdat') {
    bit(8) data[];
}
```

13.2.3.2.1.2 Semantics

data - is the contained media data

13.2.3.3 Movie Header Atom

Atom Type: 'mvhd'
 Container: Movie Atom ('moov')
 Mandatory: Yes
 Quantity: Exactly one

This atom defines overall information that is media-independent, and relevant to the entire presentation considered as a whole.

13.2.3.3.1 Syntax

```
aligned(8) class MovieHeaderAtom (unsigned int(32) version) extends FullAtom('mvhd', version,
0) {
    if (version==1) {
        unsigned int(64) creation-time;
        unsigned int(64) modification-time;
        unsigned int(32) timescale;
        unsigned int(64) duration;
    } else { // version==0
        unsigned int(32) creation-time;
        unsigned int(32) modification-time;
        unsigned int(32) timescale;
        unsigned int(32) duration;
    }
    const bit(32)reserved = 0x00010000;
    const bit(16)reserved = 0x0100;
    const bit(16)reserved = 0;
    const unsigned int(32)[2] reserved = 0;
    const bit(32)[9] reserved =
        { 0x00010000, 0, 0, 0, 0x00010000, 0, 0, 0, 0x40000000 };
    const bit(32)[6] reserved = 0;
    unsigned int(32) next-track-ID;
}
```

13.2.3.3.2 Semantics

`version` - is an integer that specifies the version (0 or 1 in this draft).

`creation-time` - is an integer which declares the creation time of the presentation (in seconds since midnight, Jan. 1, 1904).

`modification-time` - is an integer which declares the most recent time the presentation was modified (in seconds since midnight, Jan. 1, 1904).

`timescale` - is an integer which specifies the time-scale for the entire presentation; this is the number of time units which pass in one second. A time coordinate system that measures time in sixtieths of a second, for example, has a time scale of 60.

`duration` - is an integer which declares length of the presentation (in the scale of the timescale). Note that this property is derived from the presentation's tracks. The value of this field corresponds to the duration of the longest track in the presentation.

`next-track-ID` - is an integer which indicates a value to use for the track ID of the next track to be added to this presentation. Note that 0 is not a valid track ID value. This must be larger than the largest track-ID in use. If this value is equal to or larger than 65535, and a new media track is to be added, then a search must be made in the file for a free track identifier that will fit into 16 bits. If the value is all 1s (32-bit maxint) then this search is needed for all additions.

13.2.3.4 Object Descriptor Atom

Atom Type: 'iods'
 Container: Movie Atom ('moov')
 Mandatory: Yes
 Quantity: Exactly one

This object contains an Object Descriptor or an Initial Object Descriptor.

There are a number of possible file types based on usage, depending on the descriptor:

- Presentation, contains IOD which contains a BIFS stream (MP4 file)
- Sub-part of a presentation, contains an IOD without a BIFS stream (MP4 file)
- Sub-part of a presentation, contains an OD (MP4 file)
- Free-form file, Referenced by MP4 data references (free-format)

NOTE - The first three are MP4 files, the last file is not necessarily an MP4 file, as it is free-format.

13.2.3.4.1 Syntax

```
aligned(8) class ObjectDescriptorAtom
  extends FullAtom('iods', version = 0, 0) {
  ObjectDescriptor OD;
}
```

The syntax for ObjectDescriptor and InitialObjectDescriptor is described in 8.6.2 through 8.6.4.

13.2.3.4.2 Semantics

The semantics for ObjectDescriptor and InitialObjectDescriptor are described in 8.6.2 through 8.6.4.. The contents of this atom are formed by taking an object descriptor or initial object descriptor and:

- changing the tag to MP4_OD_Tag or MP4_IOD_Tag as appropriate for this object
- replacing the ES descriptors with ES_ID_Inc referencing the appropriate track.

13.2.3.5 Track Atom

Atom Type: 'trak'
 Container: Movie Atom ('moov')
 Mandatory: Yes
 Quantity: 1 or more

This is a container atom for a single track of a presentation. A presentation may consist of one or more tracks. Each track is independent of the other tracks in the presentation and carries its own temporal and spatial information. Each track will contain its associated media atom.

Tracks are used for two purposes: (a) to contain elementary media data (media tracks) and (b) to contain packetization information for streaming protocols (hint tracks).

There must be at least one media track within a MP4 file; and all the media tracks that contributed to the hint tracks present must remain in the file, even if the media data within them is not referenced by the hint tracks. After deleting all hint tracks, the entire un-hinted presentation must remain.

13.2.3.5.1 Syntax

```
aligned(8) class TrackAtom extends Atom('trak') { }
```

13.2.3.6 Track Header Atom

Atom Type: 'tkhd'
 Container: Track Atom ('trak')
 Mandatory: Yes
 Quantity: Exactly one

The track header atom specifies the characteristics of a single track. Exactly one track header atom is contained in a track.

In the absence of an edit list, the presentation of a track starts immediately. An empty edit is used to offset the start time of a track.

13.2.3.6.1 Syntax

```
aligned(8) class TrackHeaderAtom
  extends FullAtom('tkhd', version, flags){
  if (version==1) {
    unsigned int(64) creation-time;
    unsigned int(64) modification-time;
    unsigned int(32) track-ID;
    const unsigned int(32) reserved = 0;
    unsigned int(64) duration;
  } else { // version==0
    unsigned int(32) creation-time;
    unsigned int(32) modification-time;
    unsigned int(32) track-ID;
    const unsigned int(32) reserved = 0;
    unsigned int(32) duration;
  }
  const unsigned int(32)[3] reserved = 0;
  const bit(16)reserved = { if track_is_audio 0x0100 else 0 };
  const unsigned int(16) reserved = 0;
  const bit(32)[9] reserved =
    { 0x00010000, 0, 0, 0, 0x00010000, 0, 0, 0, 0x40000000 };
  const bit(32)reserved = {
    if track_is_visual 0x01400000 else 0 };
  const bit(32)reserved = {
    if track_is_visual 0x00F00000 else 0};
}
```

13.2.3.6.2 Semantics

Version – is an integer that specifies the version (0 or 1 in this draft).

flags - is a 24-bit integer with flags; the following values are defined.

Track enabled – Indicates that the track is enabled. Flag value is 0x000001. A disabled track (the low bit is zero) is treated as if it were not present.

creation-time - is an integer which declares the creation time of this track (in seconds since midnight, Jan. 1, 1904).

modification-time - is an integer which declares the most recent time the track was modified (in seconds since midnight, Jan. 1, 1904).

track-ID - is an integer which uniquely identifies this track over the entire lifetime of this presentation. Track IDs are never re-used and cannot be zero.

duration - is an integer that indicates the duration of this track (in the movie's time coordinate system). Note that this property is derived from the track's edits. The value of this field is equal to the sum of the durations of all of the track's edits. If there is no edit list, then the duration is the sum of the sample durations, converted into the movie time-scale.

13.2.3.7 Track reference atom

Atom Type: `tref'

Container: Track Atom ('trak')

Mandatory: No

Quantity: 0 or 1

The track reference atom provides a reference from the containing stream to another stream in the presentation. These references are typed. In particular, a 'hint' reference links from the containing hint track to the media data that it hints. Exactly one track reference atom can be contained within the track atom.

If this atom is not present, the track is not referencing any other track in any way. Note that the reference array is sized to fill the reference type atom.

Track references with a reference index of 0 are permitted. This indicates no reference, which can be useful to defeat the implied synchronization reference between tracks in the same file, when this implied behavior is not desired.

13.2.3.7.1 Syntax

```
aligned(8) class TrackReferenceAtom extends Atom('tref') {
}
aligned(8) class TrackReferenceTypeAtom (unsigned int(32) reference-type) extends
Atom(reference-type) {
    unsigned int(32) track-IDs[];
}
```

13.2.3.7.2 Semantics

The track reference atom contains track reference type atoms. These are structured as track reference type atoms.

The **reference-type** must be set to one of the following values:

- **hint** – the referenced track(s) contain the original media for this hint track
- **dpnd** – the referencing track has an MPEG-4 dependency on the referenced track
- **ipir** – this track contains IPI declarations for the referenced track

- mpod – the referencing track is an OD track which uses the referenced track as an included elementary stream track
- sync – this track uses the referenced track as its synchronization source.

13.2.3.8 Media atom

Atom Type: ‘mdia’
 Container: Track Atom (‘trak’)
 Mandatory: Yes
 Quantity: Exactly one

The media declaration container contains all the objects that declare information about the media data within a stream.

13.2.3.8.1 Syntax

```
aligned(8) class MediaAtom extends Atom('mdia') {  
}
```

13.2.3.9 Media header atom

Atom Type: ‘mdhd’
 Container: Media Atom (‘mdia’)
 Mandatory: Yes
 Quantity: Exactly one

The media header declares the overall media-independent information relevant to the characteristics of the media in a stream.

13.2.3.9.1 Syntax

```
aligned(8) class MediaHeaderAtom extends FullAtom('mdhd', version, 0) {  
    if (version==1) {  
        unsigned int(64) creation-time;  
        unsigned int(64) modification-time;  
        unsigned int(32) timescale;  
        unsigned int(64) duration;  
    } else { // version==0  
        unsigned int(32) creation-time;  
        unsigned int(32) modification-time;  
        unsigned int(32) timescale;  
        unsigned int(32) duration;  
    }  
    bit(1) pad = 0;  
    unsigned int(5)[3] language; // packed ISO-639-2/T language code  
    const unsigned int(16) reserved = 0;  
}
```

13.2.3.9.2 Semantics

Version - is an integer that specifies the version.

creation-time - is an integer which declares the creation time of the presentation (in seconds since midnight, Jan. 1, 1904).

modification-time - is an integer which declares the most recent time the presentation was modified (in seconds since midnight, Jan. 1, 1904).

timescale - is an integer which specifies the time-scale for this media; this is the number of time units which pass in one second. A time coordinate system that measures time in sixtieths of a second, for example, has a time scale of 60.

duration - is an integer which declares length of this media (in the scale of the timescale).

language - declares the language code for this media. See ISO 639-2/T for the set of three character codes. Each character is packed as the difference between its ASCII value and 0x60. The code is confined to being three lower-case letters, so these values are strictly positive. If the language code is unknown, it should be marked as 'und' for undetermined. The value 0 should be interpreted as undetermined.

13.2.3.10 Handler reference atom

Atom Type: 'hdlr'
 Container: Media Atom ('mdia') Atom
 Mandatory: Yes
 Quantity: 1 only

The handler atom within a Media Atom declares the process by which the media-data in the stream may be presented, and thus, the nature of the media in a stream. For example, a video handler would handle a video track.

13.2.3.10.1 Syntax

```
aligned(8) class HandlerAtom extends FullAtom('hdlr', version = 0, 0) {
    const unsigned int(32) reserved = 0;
    unsigned int(32) handler-type;
    const unsigned int(8)[12] reserved = 0;
    string name;
}
```

13.2.3.10.2 Semantics

version - is an integer that specifies the version.

handler-type - is an integer containing one of the following values:

| | |
|--------|-------------------------|
| 'odsm' | ObjectDescriptorStream |
| 'crsm' | ClockReferenceStream |
| 'sdsm' | SceneDescriptionStream |
| 'vide' | VisualStream |
| 'soun' | AudioStream |
| 'm7sm' | MPEG7Stream |
| 'ocsm' | ObjectContentInfoStream |
| 'ipsm' | IPMP Stream |
| 'mjsm' | MPEG-J Stream |
| 'hint' | Hint track |

name - is a null-terminated string in UTF-8 characters which gives a human-readable name for the stream type (for debugging and inspection purposes).

13.2.3.11 Media information atom

Atom Type: 'minf'
 Container: Media Atom ('mdia')
 Mandatory: Yes
 Quantity: Exactly one

The media information atom contains all the objects that declare characteristic information of the media in the stream.

13.2.3.11.1 Syntax

```
aligned(8) class MediaInformationAtom extends Atom('minf') { }
```

13.2.3.12 Media information header atoms

Atom Types: 'vmhd', 'smhd', 'hmhd'
 Container: Media Information Atom ('minf')

Mandatory: exactly one media header must be present
Quantity: 1 only

There is a media information header for each track type (corresponding to the media handler type). This header is used for all tracks containing visual streams.

13.2.3.12.1 Video Media Header Atom

The video media header contains general presentation information, independent of the coding, for visual media.

13.2.3.12.1.1 Syntax

```
aligned(8) class VideoMediaHeaderAtom
  extends FullAtom('vmhd', version = 0, 1) {
  const unsigned int(64) reserved = 0;
}
```

13.2.3.12.1.2 Semantics

version - is an integer that specifies the version.

13.2.3.12.2 Sound Media Header Atom

The sound media header contains general presentation information, independent of the coding, for audio media. This header is used for all tracks containing audio streams.

13.2.3.12.2.1 Syntax

```
aligned(8) class SoundMediaHeaderAtom
  extends FullAtom('smhd', version = 0, 0) {
  const unsigned int(32) reserved = 0;
}
```

13.2.3.12.2.2 Semantics

version - is an integer that specifies the version.

13.2.3.12.3 Hint Media Header Atom

The hint media header contains general information, independent of the protocol, for hint tracks.

13.2.3.12.3.1 Syntax

```
aligned(8) class HintMediaHeaderAtom
  extends FullAtom('hmhd', version = 0, 0) {
  unsigned int(16) maxPDUsize;
  unsigned int(16) avgPDUsize;
  unsigned int(32) maxbitrate;
  unsigned int(32) avgbitrate;
  unsigned int(32) slidingavgbitrate;
}
```

13.2.3.12.3.2 Semantics

version - is an integer that specifies the version.

maxPDUsize - gives the size in bytes of the largest PDU in this (hint) stream.

avgPDUsize - gives the average size of a PDU over the entire presentation.

maxbitrate - gives the maximum rate in bits/second over any window of one second.

avgbitrate - gives the average rate in bits/second over the entire presentation.

slidingavgbitrate - gives the maximum rate in bits/second over any one minute window (corresponding to the avgBitrate field in the DecoderConfigDescriptor).

13.2.3.12.4 MPEG-4 Media Header Atoms

ISO/IEC 14496 streams other than visual and audio currently use an empty MPEG-4 media header atom, as defined here. There is a set of reserved types for media headers specific to these ISO/IEC 14496 stream types.

13.2.3.12.4.1 Syntax

```
aligned(8) class Mpeg4MediaHeaderAtom
  extends FullAtom('nmhd', version = 0, flags) {
}
```

13.2.3.12.4.2 Semantics

`version` - is an integer that specifies the version.

`flags` - is a 24-bit integer with flags (currently all zero).

The following types are reserved but currently unused:

| | |
|-------------------------|--------|
| ObjectDescriptorStream | 'odhd' |
| ClockReferenceStream | 'crhd' |
| SceneDescriptionStream | 'sdhd' |
| MPEG7Stream | 'm7hd' |
| ObjectContentInfoStream | 'ochd' |
| IPMP Stream | 'iphd' |
| MPEG-J Stream | 'mjhd' |

13.2.3.13 Data information atom

Atom Type: 'dinf'
 Container: Media Information Atom ('minf')
 Mandatory: Yes
 Quantity: Exactly one

The data information atom contains objects that declare the location of the media information in a stream.

13.2.3.13.1 Syntax

```
aligned(8) class DataInformationAtom extends Atom('dinf') { }
```

13.2.3.14 Data reference atom

Atom Types: 'url', 'urn', 'dref'
 Container: Data Information Atom ('dinf')
 Mandatory: Yes
 Quantity: Exactly one

The data reference object contains a table of data references (normally URLs) which declare the location(s) of the media data used within the presentation. The data reference index in the sample description ties entries in this table to samples. A track may be split over several sources in this way.

If the flag is set indicating that the data is in the same file as this atom, then no string should be supplied in the entry field, not even an empty one.

13.2.3.14.1 Syntax

```
aligned(8) class DataEntryUrlAtom(unsigned int(32) version, bit(24) flags)
  extends FullAtom('url', version = 0, flags) {
  string location;
}
aligned(8) class DataEntryUrnAtom(unsigned int(32) version, bit(24) flags)
  extends FullAtom('urn', version = 0, flags) {
  string name;
  string location;
```

```

}
aligned(8) class DataReferenceAtom
  extends FullAtom('dref', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    DataEntryAtom(entry-version, entry-flags) data-entry;
  }
}

```

13.2.3.14.2 Semantics

version - is an integer that specifies the version.

entry-count - is an integer that counts the actual entries.

entry-version - is an integer that specifies the version.

entry-flags - is a 24-bit integer with flags; one flag is defined (x000001) which means that the media data is in the same file as the movie atom.

data-entry - is a URL or URN entry. Name is a URN, and is required in a URN entry. Location is a URL, and is required in a URL entry and optional in a URN entry, where it gives a default location to find the resource with the given name. Each is a null-terminated string using UTF-8 characters. If the self-contained flag is set; the URL form is used and no string is present; the atom terminates with the entry-flags field. The URL type should be of a service that delivers a file (e.g. URLs of type file, http, ftp etc.), which ideally also permits random access. Relative URLs are permissible and are relative to the file containing this data reference.

13.2.3.15 Sample Table atom

| | |
|------------|---------------------------------|
| Atom Type: | 'stbl' |
| Container: | Media Information Atom ('minf') |
| Mandatory: | Yes |
| Quantity: | Exactly one |

The sample table contains all the time and data indexing of the media samples in a track. Using the tables here, it is possible to locate samples in time, determine their type (e.g. I-frame or not), and determine their size, container, and offset into that container.

If the track that contains the sample table atom references no data, then the sample table atom does not need to contain any sub-atoms (this is not a very useful media track).

If the track that the sample table atom is contained in does reference data, then the following sub-atoms are required: Sample Description, Sample Size, Sample to Chunk, and Chunk Offset. All of the sub-tables of the sample table use the same total sample count. Further, the Sample Description Atom must contain at least one entry. A Sample Description Atom is required because it contains the data reference index field that indicates which Data Reference atom to use to retrieve the media samples. Without the Sample Description, it is not possible to determine where the media samples are stored. The Sync Sample atom is optional. If the Sync Sample atom is not present, all samples are sync samples.

13.2.3.15.1 Syntax

```

aligned(8) class SampleTableAtom extends Atom('stbl') {
}

```

13.2.3.16 Time to Sample Atoms

ISO/IEC 14496 composition time (CT) and decoding time (DT) are derived from the Time to Sample Atoms of which there are two types. The decoding time is derived in the Decoding Time to Sample Atom decoding time deltas between successive decoding times. The composition times are derived in the Composition Time to Sample Atom as composition time offsets from decoding time. If the composition times and decoding times are identical for every sample in the track, then only the Decoding Time to Sample Atom is required.

Note that the time to sample atoms must give durations for all samples including the last one. Durations in the ‘stts’ atom are strictly positive (non-zero). If the duration of the last sample is indeterminate, use an arbitrary small value and a ‘dwell’ edit.

In the following example, there is a sequence of I, P, and B frames, each with a decoding time delta of 10. The samples are stored as follows, with the indicated values for their decoding time deltas and composition time offsets (the actual CT and DT are given for reference). The re-ordering occurs because the predicted P frames must be decoded before the bi-directionally predicted B frames. The value of DT for a sample is always the sum of the deltas of the preceding samples. Note that the total of the decoding deltas is the duration of the media in this track.

Table 56 - Closed GOP Example

| GOP | /-- | --- | --- | --- | --- | --- | --\ | /-- | --- | --- | --- | --- | --- | --- | --\ |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | I1 | P4 | B2 | B3 | P7 | B5 | B6 | I8 | P11 | B9 | B10 | P14 | B12 | B13 | |
| DT | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | |
| CT | 10 | 40 | 20 | 30 | 70 | 50 | 60 | 80 | 110 | 90 | 100 | 140 | 120 | 130 | |
| Decode delta | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Composition Offset | 10 | 30 | 0 | 0 | 30 | 0 | 0 | 10 | 30 | 0 | 0 | 30 | 0 | 0 | |

Table 57 - Open GOP Example

| GOP | /-- | -- | -- | -- | -- | --\ | /- | -- | -- | -- | -- | -- | -- | -- | --\ |
|--------------------|-----|----|----|----|----|-----|----|----|----|-----|-----|-----|----|----|-----|
| | I3 | B1 | B2 | P6 | B4 | B5 | I9 | B7 | B8 | P12 | B10 | B11 | | | |
| DT | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | | | |
| CT | 30 | 10 | 20 | 60 | 40 | 50 | 90 | 70 | 80 | 120 | 100 | 110 | | | |
| Decode Delta | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Composition offset | 30 | 0 | 0 | 30 | 0 | 0 | 30 | 0 | 0 | 30 | 0 | 0 | | | |

13.2.3.16.1 Decoding Time to Sample atom

Atom Type: ‘stts’
 Container: Sample Table Atom (‘stbl’)
 Mandatory: Yes
 Quantity: Exactly one

This atom contains a compact version of a table that allows indexing from decoding time to sample number. Other tables give sample sizes and pointers, from the sample number. Each entry in the table gives the number of consecutive samples with the same time delta, and the delta of those samples. By adding the deltas a complete time-to-sample map may be built.

The Decoding Time to Sample Atom contains decode time delta's: $DT(n+1) = DT(n) + STTS(n)$ where STTS(n) is the (uncompressed) table entry for sample n.

The sample entries are ordered by decoding time stamps; therefore the deltas are all non-negative.

The DT axis has a zero origin; $DT(i) = \text{SUM}(\text{for } j=0 \text{ to } i-1 \text{ of delta}(j))$, and the sum of all deltas gives the length of the media in the track (not mapped to the overall timescale, and not considering any edit list).

The Edit List Atom provides the initial CT value if it is non-empty (non-zero).

13.2.3.16.1.1 Syntax

```
aligned(8) class TimeToSampleAtom
  extends FullAtom('stts', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(32) sample-count;
    int(32) sample-delta;
  }
}
```

For example with table 1.2, the entry would be:

| Sample count | Sample-delta |
|--------------|--------------|
| 14 | 10 |

13.2.3.16.1.2 Semantics

version - is an integer that specifies the version.

ttype - is 'stts' (for decoding times).

entry-count - is an integer that gives the number of entries in the following table.

sample-count - is an integer that counts the number of consecutive samples that have the given duration.

sample-delta - is an integer that gives the delta of these samples in the time-scale of the media.

13.2.3.16.2 Composition Time to Sample atom

Atom Type: 'ctts'
 Container: Sample Table Atom ('stbl')
 Mandatory: No
 Quantity: Exactly one

This atom provides the offset between decoding time and composition time. Since decoding time must be less than the composition time, the offsets are expressed as unsigned numbers such that $CT(n) = DT(n) + CTTS(n)$ where $CTTS(n)$ is the (uncompressed) table entry for sample n.

The composition time to sample table is optional and should only be present if DT and CT differ for any samples.

13.2.3.16.2.1 Syntax

```
aligned(8) class CompositionOffsetAtom
  extends FullAtom('ctts', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(32) sample-count;
    unsigned int(32) sample-offset;
  }
}
```

For example in table 1.2

| Sample count | offset |
|--------------|--------|
| 1 | 10 |
| 1 | 30 |
| 2 | 0 |
| 1 | 30 |
| 2 | 0 |
| 1 | 10 |
| 1 | 30 |
| 2 | 0 |
| 1 | 30 |
| 2 | 0 |

13.2.3.16.2.2 Semantics

version - is an integer that specifies the version, 0 in this draft.

ttype - is 'ctts' (for composition times).

entry-count - is an integer that gives the number of entries in the following table.

sample-count - is an integer that counts the number of consecutive samples that have the given offset.

sample-offset - is a non-negative integer that gives the offset between CT and DT, such that $CT(n) = DT(n) + CTTS(n)$.

13.2.3.17 Sample description atom

Atom Types: 'mp4v', 'mp4a', 'mp4s'

Container: Sample Table Atom ('stbl')

Mandatory: Yes

Quantity: Exactly one

The sample description table gives detailed information about the coding type used, and any initialization information needed for that coding.

The information stored in the data array is stream-type specific, and may have variants within a stream type (e.g. different codings may use different specific information after some common fields, even within a visual stream).

For visual streams, a VisualSampleEntry is used; for audio streams, an AudioSampleEntry. For all other MPEG-4 streams, a MpegSampleEntry is used. Hint tracks use an entry format specific to their protocol, with an appropriate name.

For all the MPEG-4 streams, the data field stores an ES_Descriptor with all its contents. Note that this provides an SICConfigDescriptor which uses a pre-defined value solely for use within files.

For hint tracks, the sample description contains appropriate declarative data for the TransMux being used, and the format of the hint track. The definition of the sample description is specific to the TransMux. However, note the discussion of FlexMux above, and the need for a Stream Map table, and MuxCode mode format definitions.

Note that multiple descriptions may be used within a stream.

13.2.3.17.1 Syntax

```

aligned(8) class ESDAtom
    extends FullAtom('esds', version = 0, 0) {
    ES_DescriptorES;
}
aligned(8) abstract class SampleEntry (unsigned int(32) format)
    extends Atom(format){
    const unsigned int(8)[6] reserved = 0;
    unsigned int(16) data-reference-index;
}
class HintSampleEntry() extends SampleEntry (protocol) {
unsigned int(8) data [];
}
// Visual Streams

class VisualSampleEntry() extends SampleEntry ('mp4v') {const unsigned int(32)[4] reserved = 0;
const unsigned int(32) reserved = 0x014000F0;
const unsigned int(32) reserved = 0x00480000;
const unsigned int(32) reserved = 0x00480000;
const unsigned int(32) reserved = 0;
const unsigned int(16) reserved = 1;
const unsigned int(8)[32] reserved = 0;
const unsigned int(16) reserved = 24;

```

```

const int(16) reserved = -1;
ESDAtom ES;
}
// Audio Streams

class AudioSampleEntry() extends SampleEntry ('mp4a'){
const unsigned int(32)[2] reserved = 0;
const unsigned int(16) reserved = 2 ;
const unsigned int(16) reserved = 16 ;
const unsigned int(32) reserved = 0 ;
unsigned int(16) time-scale ; // copied from track
const unsigned int(16) reserved = 0 ;
ESDAtom ES;
}
// all other Mpeg stream types
class MpegSampleEntry() extends SampleEntry ('mp4s'){
ESDAtom ES;
}
aligned(8) class SampleDescriptionAtom (unsigned int(32) handler-type)
extends FullAtom('stsd', 0, 0){
int i ;
unsigned int(32) entry-count;
for (i = 0 ; i < entry-count ; i++){
switch (handler-type){
case 'soun': // AudioStream
AudioSampleEntry();
break;
case 'vide': // VisualStream
VisualSampleEntry();
break;
case 'hint': // Hint track
HintSampleEntbry();
break;
default :
MpegSampleEntry();
break;
}
}
}

```

13.2.3.17.2 Semantics

`version` - is an integer that specifies the version.

`entry-count` - is an integer that gives the number of entries in the following table.

`SampleEntry` - is the appropriate sample entry.

`data-reference-index` - is integer that contains the index of the data reference to use to retrieve data associated with samples that use this sample description. Data references are stored in data reference atoms. The index ranges from 1 to the number of data references.

`data` - is information specific to the protocol.

`ES` - is the ES Descriptor for this stream.

13.2.3.18 Sample size atom

| | |
|------------|----------------------------|
| Atom Type: | 'stsz' |
| Container: | Sample Table Atom ('stbl') |
| Mandatory: | Yes |
| Quantity: | Exactly one |

The sample size atom contains the sample count and a table giving the size of each sample. This allows the media data itself to be unframed. The total number of samples in the media is always indicated in the sample count. If the default size is indicated, then no table follows.

13.2.3.18.1 Syntax

```
aligned(8) class SampleSizeAtom extends FullAtom('stsz', version = 0, 0) {
    unsigned int(32) sample-size;
    unsigned int(32) sample-count;
    if (sample-size==0) {
        int i;
        for (i=0; i < sample-count; i++) {
            unsigned int(32) entry-size;
        }
    }
}
```

13.2.3.18.2 Semantics

`version` - is an integer that specifies the version.

`sample-size` - is integer specifying the default sample size. If all the samples are the same size, this field contains that size value. If this field is set to 0, then the samples have different sizes, and those sizes are stored in the sample size table.

`sample-count` - is an integer that gives the number of entries in the following table.

`entry-size` - is integer specifying the size of a sample, indexed by its number.

13.2.3.19 Sample to chunk atom

Atom Type: 'stsc'
 Container: Sample Table Atom ('stbl')
 Mandatory: Yes
 Quantity: Exactly one

Samples within the media data are grouped into chunks. Chunks may be of different sizes, and the samples within a chunk may have different sizes. By using this table, you can find the chunk that contains a sample, its position, and the associated sample description.

The table is compactly coded. Each entry gives the index of the first chunk of a run of chunks with the same characteristics; by subtracting one entry here from the previous one, you can compute how many chunks are in this run. You can convert this to a sample count by multiplying by the appropriate samples-per-chunk.

13.2.3.19.1 Syntax

```
aligned(8) class SampleToChunkAtom
    extends FullAtom('stsc', version = 0, 0) {
    unsigned int(32) entry-count;
    int i;
    for (i=0; i < entry-count; i++) {
        unsigned int(32) first-chunk;
        unsigned int(32) samples-per-chunk;
        unsigned int(32) sample-description-index;
    }
}
```

13.2.3.19.2 Semantics

`version` - is an integer that specifies the version.

`entry-count` - is an integer that gives the number of entries in the following table.

`first-chunk` - is an integer that gives the index of the first chunk in this run of chunks that share the same samples-per-chunk and sample-description-index.

`samples-per-chunk` - is an integer that gives the number of samples in each of these chunks.

`sample-description-index` - is an integer that gives the index of the sample entry that describes the samples in this chunk. The index ranges from 1 to the number of sample entries in the sample description atom.

13.2.3.20 Chunk offset atom

Atom Type: 'stco'
 Container: Sample Table Atom ('stbl')
 Mandatory: Yes
 Quantity: Exactly one

The chunk-offset table gives the index of each chunk into the containing file. There are two variants, permitting the use of 32-bit or 64-bit offsets. The latter is useful when managing very large presentations. At most one of these variants will occur in any single instance of a sample table.

Note that offsets are file offsets not the offset into any atom within the file (e.g. a mdat atom). This permits referring to media data in files without any atom structure. It does also mean that care must be taken when constructing a self-contained mp4 file with its meta-data (movie atom) at the front, as the size of the movie atom will affect the chunk offsets to the media data.

13.2.3.20.1 Syntax

```
aligned(8) class ChunkOffsetAtom
  extends FullAtom('stco', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(32) chunk-offset;
  }
}

aligned(8) class ChunkLargeOffsetAtom
  extends FullAtom('co64', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(64) chunk-offset;
  }
}
```

13.2.3.20.2 Semantics

version - is an integer that specifies the version.

entry-count - is an integer that gives the number of entries in the following table.

chunk-offset - is a 32 or 64 bit integer that gives the offset of the start of a chunk into its containing media stream (file).

13.2.3.21 Sync Sample Atom

Atom Type: 'stss'
 Container: Sample Table Atom ('stbl')
 Mandatory: No
 Quantity: Exactly one

The sync sample atom provides a compact marking of the random access points within the stream. Precisely the samples named here would have the RandomAccessPoint flag set in their SL Packet headers. The table is arranged in strictly increasing order of sample number.

If this table is not present, every sample is a random access point.

13.2.3.21.1 Syntax

```
aligned(8) class SyncSampleAtom
  extends FullAtom('stss', version = 0, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(32) sample-number;
  }
}
```

13.2.3.21.2 Semantics

`version` - is an integer that specifies the version.

`entry-count` - is an integer that gives the number of entries in the following table.

`sample-number` - gives the numbers of the samples that are random access points in the stream.

13.2.3.22 Shadow Sync Sample Atom

Atom Type: 'stsh'
 Container: Sample Table Atom ('stbl')
 Mandatory: No
 Quantity: Exactly one

The shadow sync table provides an optional set of sync samples that can be used when seeking or for similar purposes. In normal forward play they are ignored.

Each entry in the ShadowSyncTable consists of a pair of sample numbers. The first entry (shadowed-sample-number) indicates the number of the sample that a shadow sync will be defined for. This should always be a non-sync sample (e.g. a frame difference). The second sample number (sync-sample-number) indicates the sample number of the sync sample (i.e. key frame) that can be used when there is a random access at, or before, the shadowed-sample-number.

The entries in the ShadowSyncAtom must be sorted based on the shadowed-sample-number field.

The shadow sync samples are normally placed in an area of the track that is not presented during normal play (edited out by means of an edit list), though this is not a requirement. Note that shadow sync table can be ignored and the track will play (and seek) correctly if it is ignored (though perhaps not optimally).

The ShadowSyncSample replaces, not augments, the sample which it shadows (i.e. the next sample sent is shadowed-sample-number+1). The shadow sync sample is treated as if it occurred at the time of the sample it shadows, having the duration of the sample it shadows.

Hinting and transmission might become more complex if a shadow sample is used also as part of normal playback, or is used more than once as a shadow. In this case the hint track might need separate shadow syncs, all of which can get their media data from the one shadow sync in the media track, to allow for the different time-stamps etc. needed in their headers.

13.2.3.22.1 Syntax

```
aligned(8) class ShadowSyncSampleAtom
  extends FullAtom('stsh', version = 0, 0) {
  unsigned int(32)   entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    unsigned int(32)   shadowed-sample-number;
    unsigned int(32)   sync-sample-number;
  }
}
```

13.2.3.22.2 Semantics

`version` - is an integer that specifies the version.

`entry-count` - is an integer that gives the number of entries in the following table.

`shadowed-sample-number` - gives the number of a sample for which there is an alternative sync sample.

`sync-sample-number` - gives the number of the alternative sync sample.

13.2.3.23 Degradation Priority Atom ('stdp')

Atom Type: 'stdp'
 Container: Sample Table Atom ('stbl').
 Mandatory: No.
 Quantity: Exactly one.

The degradation priority atom contains the MPEG-4 degradation priority of each sample. The values are stored in the table, one for each sample. The size of the table, sample-count is taken from the sample-count in the Sample Size Atom ('sts').

The maximum size of a degradation priority in the SL header is 15 bits, A fixed 15-bit field is used here.

13.2.3.23.1 Syntax

```
aligned(8) class DegradationPriorityAtom
  extends FullAtom('stdp', version = 0, 0) {
  int i;
  for (i=0; i < sample-count; i++) {
    const bit(1) pad = 0; // must be zero
    unsigned int(15) priority;
  }
}
```

13.2.3.23.2 Semantics

version - is an integer that specifies the version.

priority - is integer specifying the degradation priority for each sample.

13.2.3.24 Free space atom

Atom Types: 'free', 'skip'
 Container: File
 Mandatory: No
 Quantity: Any number

The contents of a free-space atom are irrelevant and may be ignored, or the object deleted, without affecting the presentation. (Note that deleting the object may invalidate the offsets used in the sample table, unless this object is after all the media data).

13.2.3.24.1 Syntax

```
aligned(8) class FreeSpaceAtom extends Atom(free-type) {
  unsigned int(8) data[];
}
```

13.2.3.24.2 Semantics

free-type - may be 'free' or 'skip'.

13.2.3.25 Edit Atom

Atom Type: 'edts'
 Container: Track Atom ('trak')
 Mandatory: No
 Quantity: Exactly one

An edit atom maps the presentation time-line to the media time-line as it is stored in the file. The edit atom is a container for the edit lists.

Note that the Edit atom is optional. In the absence of this atom, there is an implicit one-to-one mapping of these time-lines.

In the absence of an edit list, the presentation of a track starts immediately. An empty edit is used to offset the start time of a track.

13.2.3.25.1 Syntax

```
aligned(8) class EditAtom extends Atom('edts') { }
```

13.2.3.26 Edit List Atom

Atom Type: 'elst'
 Container: Edit Atom ('edts')
 Mandatory: No
 Quantity: 1 only

The edit list atom contains an explicit timeline map. It is possible to represent 'empty' parts of the timeline, where no media is presented; a 'dwell', where a single time-point in the media is held for a period; and a normal mapping.

Edit lists provide a mapping from the relative time (the deltas in the sample table) into absolute time (the time line of the presentation), possibly introducing 'silent' intervals or repeating pieces of media.

Starting offsets for tracks (streams) are represented by an initial empty edit. For example, to play a track from its start for 30 seconds, but at 10 seconds into the presentation, we have the following edit list:

```
Entry-count = 2

Segment-duration = 10 seconds
Media-Time = -1
Media-Rate = 1

Segment-duration = 30 seconds (could be the length of the whole track)
Media-Time = 0 seconds
Media-Rate = 1
```

13.2.3.26.1 Syntax

```
aligned(8) class EditListAtom extends FullAtom('elst', version, 0) {
  unsigned int(32) entry-count;
  int i;
  for (i=0; i < entry-count; i++) {
    if (version==1) {
      unsigned int(64) segment-duration;
      int(64) media-time;
    } else { // version==0
      unsigned int(32) segment-duration;
      int(32) media-time;
    }
    int(16) media-rate;
  const int(16) reserved = 0;
  }
}
```

13.2.3.26.2 Semantics

version - is an integer that specifies the version.

entry-count - is an integer that gives the number of entries in the following table.

segment-duration - is an integer that specifies the duration of this edit segment in units of the movie's time scale.

media-time - is an integer containing the starting time within the media of this edit segment (in media time scale units, in composition time). If this field is set to -1, it is an empty edit. The last edit in a track should never be an empty edit. Any difference between the movie's duration and the track's duration is expressed as an implicit empty edit.

media-rate - specifies the relative rate at which to play the media corresponding to this edit segment. If this value is 0, then the edit is specifying a 'dwell': the media at media-time is presented for the segment-duration. Otherwise this field must contain the value 1.

13.2.3.27 User-data atom

Atom Type: 'udta'
Container: Movie Atom ('moov') or Track Atom ('trak')
Mandatory: No
Quantity: Any quantity

The stream user-data atom contains objects that declare user information about the containing atom and its data (presentation or stream).

The user-data atom is a container atom for informative user-data. This user data is formatted as a set of atoms with more specific atom types, which declare more precisely their content.

Only a copyright notice is defined in this draft. There may be multiple copyright atoms using different language codes.

13.2.3.27.1 Syntax

```
aligned(8) class UserDataAtom extends Atom('udta') {  
}  
aligned(8) class CopyrightAtom  
    extends FullAtom('cprt', version = 0, 0) {  
    const bit(1) pad = 0;  
    unsigned int(5)[3] language; // packed ISO-639-2/T language code  
    string notice;  
}
```

13.2.3.27.2 Semantics

language - declares the language code for the following text. See ISO 639-2/T for the set of three character codes. Each character is packed as the difference between its ASCII value and 0x60. The code is confined to being three lower-case letters, so these values are strictly positive.

notice - is a null-terminated string giving a copyright notice.

13.3 Extensibility

13.3.1 Objects

The normative objects defined in this specification are identified by a 32-bit value, which is normally a set of four printable characters from the ISO 8859-1 character set.

To permit user extension of the format, to store new object types, and to permit the inter-operation of the files formatted to this specification with certain distributed computing environments, there is a type mapping and a type extension mechanism which together form a pair.

Commonly used in distributed computing are UUIDs (universal unique identifiers), which are 16 bytes. Any MPEG-4 normative type specified here may be mapped directly into the UUID space by composing the four byte type value with the twelve byte MPEG reserved value, 0xxxxxxxxx-0011-0010-8000-00AA00389B71. The four-character code replaces the XXXXXXXX in the preceding number. These types are identified to MPEG as the object types used in this specification.

User objects use the escape type 'uuid'. They are documented above. After the size and type fields, there is a full 16-byte UUID.

Systems which wish to treat every object as having a UUID should employ the following algorithm:

```
size := read_uint32();
type := read_uint32();
if (type=='uuid')
    then uuid := read_uuid()
    else uuid := form_uuid(type, MPEG_12_bytes);
```

Similarly when linearizing a set of objects into files formatted to this specification, the following is applied:

```
write_uint32( object_size(object) );
uuid := object_uuid_type(object);
if (is_MPEG_uuid(uuid) )
    write_uint32( MPEG_type_of(uuid) )
    else { write_uint32('uuid'); write_uuid(uuid); }
```

A file containing MPEG-4 objects which have been written using the ‘uuid’ escape and the full UUID is not compliant; systems may choose to read objects using the uuid escape and an MPEG-4 uuid as equivalent to the MPEG-4 object of the same type as equivalent, or not.

13.3.2 Elementary streams

MPEG-4 streams may be combined into a presentation with other streams. Such streams and their declarations are beyond the scope of this specification.

13.3.3 TransMuxes (protocols)

Hint tracks may be defined for a number of different protocols depending on the desired delivery mechanism. Examples would include RTP and MPEG-2 Transport.

13.3.4 Storage formats

The main file containing the meta-data may use other files to contain media-data. These other files may contain header declarations from a variety of standards, including this one.

If such a secondary file has a meta-data declaration set in it, that meta-data is not part of the overall presentation. This allows small presentation files to be aggregated into a larger overall presentation by building new meta-data and referencing the media-data, rather than copying it.

The references into these other files need not use all the data in those files; in this way, a subset of the media-data may be used, or unwanted headers ignored.

14 Syntactic Description Language

14.1 Introduction

This subclause describes the mechanism with which bitstream syntax is documented in ISO/IEC 14496. This mechanism is based on a Syntactic Description Language (SDL), documented here in the form of syntactic description rules. It directly extends the C-like syntax used in ISO/IEC 11172:1993 and ISO/IEC 13818:1996 into a well-defined framework that lends itself to object-oriented data representations. In particular, SDL assumes an object-oriented underlying framework in which bitstream units consist of “classes.” This framework is based on the typing system of the C++ and Java programming languages. SDL extends the typing system by providing facilities for defining bitstream-level quantities, and how they should be parsed.

The elementary constructs are described first, followed by the composite syntactic constructs, and arithmetic and logical expressions. Finally, syntactic control flow and built-in functions are addressed. Syntactic flow control is needed to take into account context-sensitive data. Several examples are used to clarify the structure.

14.2 Elementary Data Types

The SDL uses the following elementary data types:

1. Constant-length direct representation bit fields or Fixed Length Codes — FLCs. These describe the encoded value exactly as it is to be used by the appropriate decoding process.

2. Variable length direct representation bit fields, or parametric FLCs. These are FLCs for which the actual length is determined by the context of the bitstream (e.g., the value of another parameter).
3. Constant-length indirect representation bit fields. These require an extra lookup into an appropriate table or variable to obtain the desired value or set of values.
4. Variable-length indirect representation bit fields (e.g., Huffman codes).

These elementary data types are described in more detail in the clauses to follow immediately.

All quantities shall be represented in the bitstream with the most significant byte first, and also with the most significant bit first.

14.2.1 Constant-Length Direct Representation Bit Fields

Constant-length direct representation bit fields shall be represented as:

Rule E.1: Elementary Data Types

`[aligned] type[(length)] element_name [= value]; // C++-style comments allowed`

The **type** may be any of the following: **int** for signed integer, **unsigned int** for unsigned integer, **double** for floating point, and **bit** for raw binary data. The **length** attribute indicates the length of the element in bits, as it is actually stored in the bitstream. Note that a data **type** equal to **double** shall only use 32 or 64 bit lengths. The **value** attribute shall be present only when the value is fixed (e.g., start codes or object IDs), and it may also indicate a range of values (i.e., ‘0x01..0xAF’). The **type** and the optional **length** attributes are always present, except if the data is non-parsable, i.e., it is not included in the bitstream. The keyword **aligned** indicates that the data is aligned on a byte boundary. As an example, a start code would be represented as:

```
aligned bit(32) picture_start_code=0x00000100;
```

An optional numeric modifier, as in **aligned(32)**, may be used to signify alignment on other than byte boundary. Allowed values are 8, 16, 32, 64, and 128. Any skipped bits due to alignment shall have the value ‘0’. An entity such as temporal reference would be represented as:

```
unsigned int(5) temporal_reference;
```

where **unsigned int(5)** indicates that the element shall be interpreted as a 5-bit unsigned integer. By default, data shall be represented with the most significant bit first, and the most significant byte first.

The value of parsable variables with declarations that fall outside the flow of declarations (see 14.6) shall be set to 0.

Constants shall be defined using the keyword **const**.

EXAMPLE —

```
const int SOME_VALUE=255; // non-parsable constant
const bit(3) BIT_PATTERN=1; // this is equivalent to the bit string "001"
```

To designate binary values, the **0b** prefix shall be used, similar to the **0x** prefix for hexadecimal numbers. A period (‘.’) may be optionally placed after every four digits for readability. Hence **0xF** is equivalent to **0b0000.1111**.

In several instances, it may be desirable to examine the immediately following bits in the bitstream, without actually consuming these bits. To support this behavior, a ‘*’ character shall be placed after the parse size parentheses to modify the parse size semantics.

Rule E.2: Look-ahead parsing

`[aligned] type (length)* element_name;`

For example, the value of next 32 bits in the bitstream can be checked to be an unsigned integer without advancing the current position in the bitstream using the following representation:

```
aligned unsigned int (32)* next_code;
```

14.2.2 Variable Length Direct Representation Bit Fields

This case is covered by Rule E.1, by allowing the *length* attribute to be a variable included in the bitstream, a non-parsable variable, or an expression involving such variables.

EXAMPLE —

```
unsigned int(3) precision;
int(precision) DC;
```

14.2.3 Constant-Length Indirect Representation Bit Fields

Indirect representation indicates that the actual value of the element at hand is indirectly specified by the bitstream through the use of a table or map. In other words, the value extracted from the bitstream is an index to a table from which the final desired value is extracted. This indirection may be expressed by defining the map itself:

Rule E.3: Maps

```
map MapName (output_type) {
    index, {value_1, ... value_M},
    ...
}
```

These tables are used to translate or map bits from the bitstream into a set of one or more values. The input type of a **map** (the *index* specified in the first column) shall always be **bit**. The *output_type* entry shall be either a predefined type or a defined class (classes are defined in 14.3.1). The **map** is defined as a set of pairs of such indices and values. Keys are binary string constants while values are *output_type* constants. Values shall be specified as aggregates surrounded by curly braces, similar to C or C++ structures.

EXAMPLE —

```
class YUVblocks { // classes are fully defined later on
    int Yblocks;
    int Ublocks;
    int Vblocks;
}

// a table that relates the chroma format with the number of blocks
// per signal component
map blocks_per_component (YUVblocks) {
    0b00, {4, 1, 1}, // 4:2:0
    0b01, {4, 2, 2}, // 4:2:2
    0b10, {4, 4, 4} // 4:4:4
}
```

The next rule describes the use of such a **map**.

Rule E.4: Mapped Data Types

```
type (MapName) name;
```

The **type** of the variable shall be identical to the **type** returned from the **map**.

EXAMPLE —

```
YUVblocks(blocks_per_component) chroma_format;
```

Using the above declaration, a particular value of the **map** may be accessed using the construct: `chroma_format.Ublocks`.

14.2.4 Variable Length Indirect Representation Bit Fields

For a variable length element utilizing a Huffman or variable length code table, an identical specification to the fixed length case shall be used:

```
class val {
    unsigned int foo;
    int bar;
}

map sample_vlc_map (val) {
    0b0000.001, {0, 5},
    0b0000.0001, {1, -14}
}
```

The only difference is that the indices of the **map** are now of variable length. The variable-length codewords are (as before) binary strings, expressed by default in ‘0b’ or ‘0x’ format, optionally using the period (‘.’) every four digits for readability.

Very often, variable length code tables are partially defined. Due to the large number of possible entries, it may be inefficient to keep using variable length codewords for all possible values. This necessitates the use of escape codes, that signal the subsequent use of a fixed-length (or even variable length) representation. To allow for such exceptions, parsable type declarations are allowed for **map** values.

EXAMPLE — This example uses the class type ‘val’ as defined above.

```
map sample_map_with_esc (val) {
    0b0000.001, {0, 5},
    0b0000.0001, {1, -14},
    0b0000.0000.1, {5, int(32)},
    0b0000.0000.0, {0, -20}
}
```

When the codeword 0b0000.0000.1 is encountered in the bitstream, then the value ‘5’ is assigned to the first element (*val.foo*). The following 32 bits are parsed and assigned as the value of the second element (*val.bar*). Note that, in case more than one element utilizes a parsable type declaration, the order is significant and is the order in which elements are parsed. In addition, the type within the **map** declaration shall match the type used in the class declaration associated with the **map**’s return type.

14.3 Composite Data Types

14.3.1 Classes

Classes are the mechanism with which definitions of composite types or objects is performed. Their definition is as follows.

Rule C.1: Classes

```
[aligned] [abstract] [expandable[(maxClassSize)]] class object_name [extends parent_class] [:  
    bit(length) [id_name=] object_id | id_range ] {  
    [element; ...] // zero or more elements  
}
```

The different elements within the curly braces are the definitions of the elementary bitstream components discussed in 12.2 or control flow elements that will be discussed in a subsequent subclause.

The optional keyword **extends** specifies that the **class** is “derived” from another **class**. Derivation implies that all information present in the base **class** is also present in the derived **class**, and that, in the bitstream, all such information *precedes* any additional bitstream syntax declarations specified in the new **class**.

The optional attribute *id_name* allows to assign an *object_id*, and, if present, is the key demultiplexing entity which allows differentiation between base and derived objects. It is also possible to have a range of possible values: the *id_range* is specified as *start_id* .. *end_id*, inclusive of both bounds.

If the attribute `id_name` is used, a derived **class** may appear at any point in the bitstream where its base **class** is specified in the syntax. This allows to express polymorphism in the SDL syntax description. The actual **class** to be parsed is determined as follows:

- The base **class** declaration shall assign a constant value or range of values to *object_id*.
- Each derived **class** declaration shall assign a constant value or ranges of values to *object_id*. This value or set of values shall correspond to legal *object_id* value(s) for the base **class**.

NOTE 1 — Derivation of classes is possible even when *object_ids* are not used. However, in that case derived classes may not replace their base **class** in the bitstream.

NOTE 2 — Derived classes may use the same *object_id* value as the base **class**. In that case classes can only be discriminated through context information.

EXAMPLE —

```
class slice: aligned bit(32) slice_start_code=0x00000101 .. 0x000001AF {
    // here we get vertical_size_extension, if present
    if (scalable_mode==DATA_PARTITIONING) {
        unsigned int(7) priority_breakpoint;
    }
    ...
}

class foo {
    int(3) a;
    ...
}

class bar extends foo {
    int(5) b; // this b is preceded by the 3 bits of a
    int(10) c;
    ...
}
```

The order of declaration of the bitstream components is important: it is the same order in which the elements appear in the bitstream. In the above examples, `bar.b` immediately precedes `bar.c` in the bitstream.

Objects may also be encapsulated within other objects. In this case, the *element* in Rule C.1 is an object itself.

14.3.2 Abstract Classes

When the **abstract** keyword is used in the **class** declaration, it indicates that only derived classes of this **class** shall be present in the bitstream. This implies that the derived classes may use the entire range of IDs available. The declaration of the abstract **class** requires a declaration of an ID, with the value 0.

EXAMPLE —

```
abstract class Foo : bit(1) id=0 { // the value 0 is not really used
    ...
}

// derived classes are free to use the entire range of IDs
class Foo0 extends Foo : bit(1) id=0 {
    ...
}

class Fool extends Foo : bit(1) id=1 {
    ...
}

class Example {
    Foo f; // can only be Foo0 or Fool, not Foo
}
```

14.3.3 Expandable classes

When the **expandable** keyword is used in the **class** declaration, it indicates that the **class** may contain implicit arrays or undefined trailing data, called the "expansion". In this case the **class** encodes its own size in bytes explicitly. This may be used for classes that require future compatible extension or that may include private data. A legacy device is able to decode an expandable **class** up to the last parsable variable that has been defined for a given revision of this **class**. Using the size information, the parser shall skip the **class** data following the last known syntax element. Anywhere in the syntax where a set of expandable classes with *object_id* is expected it is permissible to intersperse expandable classes with unknown *object_id* values. These classes shall be skipped, using the size information.

The size encoding precedes any parsable variables of the **class**. If the **class** has an *object_id*, the encoding of the *object_id* precedes the size encoding. The size information shall not include the number of bytes needed for the size and the *object_id* encoding. Instances of expandable classes shall always have a size corresponding to an integer number of bytes. The size information is accessible within the class as class instance variable **sizeOfInstance**.

If the **expandable** keyword has a *maxClassSize* attribute, then this indicates the maximum permissible size of this **class** in bytes, including any expansion.

The length encoding is itself defined in SDL as follows:

```
int sizeOfInstance = 0;
bit(1) nextByte;
bit(7) sizeOfInstance;
while(nextByte) {
    bit(1) nextByte;
    bit(7) sizeByte;
    sizeOfInstance = sizeOfInstance<<7 | sizeByte;
}
```

14.3.4 Parameter types

A parameter type defines a **class** with parameters. This is to address cases where the data structure of the **class** depends on variables of one or more other objects. Since SDL follows a declarative approach, references to other objects, in such cases, cannot be performed directly (none is instantiated). Parameter types provide placeholders for such references, in the same way as the arguments in a C function declaration. The syntax of a **class** definition with parameters is as follows.

Rule C.2: Class Parameter Types

```
[aligned] [abstract] class object_name [(parameter list)] [extends parent_class]
                                [: bit(length) [id_name=] object_id | id_range] {
    [element; ...] // zero or more elements
}
```

The parameter list is a list of **type** names and variable name pairs separated by commas. Any element of the bitstream, or value derived from the bitstream with a variable-length codeword, or a constant, can be passed as a parameter.

A **class** that uses parameter types is dependent on the objects in its parameter list, whether **class** objects or simple variables. When instantiating such a **class** into an object, the parameters have to be instantiated objects of their corresponding classes or types.

EXAMPLE —

```
class A {
    // class body
    ...
    unsigned int(4) format;
}
```

```

class B (A a, int i) {      // B uses parameter types
    unsigned int(i) bar;
    ...
    if( a.format == SOME_FORMAT ) {
        ...
    }
    ...
}

class C {
    int(2) i;
    A a;
    B foo( a, I); // instantiated parameters are required
}

```

14.3.5 Arrays

Arrays are defined in a similar way as in C/C++, i.e., using square brackets. Their length, however, can depend on run-time parameters such as other bitstream values or expressions that involve such values. The array declaration is applicable to both elementary as well as composite objects.

Rule A.1: Arrays

typespec *name* [*length*];

typespec is a **type** specification (including bitstream representation information, e.g. ‘**int(2)**’). The attribute *name* is the name of the array, and *length* is its length.

EXAMPLE —

```

unsigned int(4) a[5];
int(10) b;
int(2) c[b];

```

Here ‘a’ is an array of 5 elements, each of which is represented using 4 bits in the bitstream and interpreted as an unsigned integer. In the case of ‘c’, its length depends on the actual value of ‘b’. Multi-dimensional arrays are allowed as well. The parsing order from the bitstream corresponds to scanning the array by incrementing first the right-most index of the array, then the second, and so on.

14.3.6 Partial Arrays

In several situations, it is desirable to load the values of an array one by one, in order to check, for example, a terminating or other condition. For this purpose, an extended array declaration is allowed in which individual elements of the array may be accessed.

Rule A.2: Partial Arrays

typespec *name*[[*index*]];

Here *index* is the element of the array that is defined. Several such partial definitions may be given, but they shall all agree on the **type** specification. This notation is also valid for multidimensional arrays.

EXAMPLE —

```
int(4) a[[3]][[5]];
```

indicates the element a(5, 3) of the array (the element in the 6th row and the 4th column), while

```
int(4) a[3][[5]];
```

indicates the entire sixth column of the array, and

```
int(4) a[[3]][5];
```

indicates the entire fourth row of the array, with a length of 5 elements.

NOTE — **a[5]** means that the array has five elements, whereas **a[[5]]** implies that there are at least six.

14.3.7 Implicit Arrays

When a series of polymorphic classes is present in the bitstream, it may be represented as an array of the same type as that of the base **class**. Let us assume that a set of polymorphic classes is defined, derived from the base **class** Foo (may or may not be abstract):

```
class Foo : int(16) id = 0 {
    ...
}
```

For an array of such objects, it is possible to implicitly determine the length by examining the validity of the **class** ID. Objects are inserted in the array as long as the ID can be properly resolved to one of the IDs defined in the base (if not abstract) or its derived classes. This behavior is indicated by an array declaration without a length specification.

EXAMPLE 1 —

```
class Example {
    Foo f[]; // length implicitly obtained via ID resolution
}
```

To limit the minimum and maximum length of the array, a range specification may be inserted in the specification of the length.

EXAMPLE 2 —

```
class Example {
    Foo f[1 .. 255]; // at least 1, at most 255 elements
}
```

In this example, ‘f’ may have at least 1 and at most 255 elements.

14.4 Arithmetic and Logical Expressions

All standard arithmetic and logical operators of C++ are allowed, including their precedence rules.

14.5 Non-Parsable Variables

In order to accommodate complex syntactic constructs, in which context information cannot be directly obtained from the bitstream but only as a result of a non-trivial computation, non-parsable variables are allowed. These are strictly of local scope to the **class** they are defined in. They may be used in expressions and conditions in the same way as bitstream-level variables. In the following example, the number of non-zero elements of an array is computed.

```
unsigned int(6) size;
int(4) array[size];
...
int i; // this is a temporary, non-parsable variable
for (i=0, n=0; i<size; i++) {
    if (array[[i]]!=0)
        n++;
}

int(3) coefficients[n];
// read as many coefficients as there are non-zero elements in array
```

14.6 Syntactic Flow Control

The syntactic flow control provides constructs that allow conditional parsing, depending on context, as well as repetitive parsing. The familiar C/C++ if-then-else construct is used for testing conditions. Similarly to C/C++, zero corresponds to false, and non-zero corresponds to true.

Rule FC.1: Flow Control Using If-Then-Else

```
if (condition) {
    ...
} [else if (condition) {
    ...
}] [else {
    ...
}]
```

EXAMPLE 1 —

```
class conditional_object {
    unsigned int(3) foo;
    bit(1) bar_flag;
    if (bar_flag) {
        unsigned int(8) bar;
    }
    unsigned int(32) more_foo;
}
```

Here the presence of the entity ‘bar’ is determined by the ‘bar_flag’.

EXAMPLE 2 —

```
class conditional_object {
    unsigned int(3) foo;
    bit(1) bar_flag;
    if (bar_flag) {
        unsigned int(8) bar;
    } else {
        unsigned int(some_vlc_table) bar;
    }
    unsigned int(32) more_foo;
}
```

Here we allow two different representations for ‘bar’, depending on the value of ‘bar_flag’. We could equally well have another entity instead of the second version (the variable length one) of ‘bar’ (another object, or another variable). Note that the use of a flag necessitates its declaration before the conditional is encountered. Also, if a variable appears twice (as in the example above), the types shall be identical.

In order to facilitate cascades of if-then-else constructs, the ‘switch’ statement is also allowed.

Rule FC.2: Flow Control Using Switch

```
switch (condition) {
    [case label1: ...]
    [default:]
}
```

The same category of context-sensitive objects also includes iterative definitions of objects. These simply imply the repetitive use of the same syntax to parse the bitstream, until some condition is met (it is the conditional repetition that implies context, but fixed repetitions are obviously treated the same way). The familiar structures of ‘for’, ‘while’, and ‘do’ loops can be used for this purpose.

Rule FC.3: Flow Control Using For

```
for (expression1; expression2; expression3) {
    ...
}
```

expression1 is executed prior to starting the repetitions. Then *expression2* is evaluated, and if it is non-zero (true) the declarations within the braces are executed, followed by the execution of *expression3*. The process repeats until *expression2* evaluates to zero (false).

Note that it is not allowed to include a variable declaration in *expression1* (in contrast to C++).

Rule FC.4: Flow Control Using Do

```
do {  
    ...  
} while (condition);
```

Here the block of statements is executed until *condition* evaluates to false. Note that the block will be executed at least once.

Rule FC.5: Flow Control Using While

```
while (condition) {  
    ...  
}
```

The block is executed zero or more times, as long as *condition* evaluates to non-zero (true).

14.7 Built-In Operators

The following built-in operators are defined.

Rule O.1: lengthof() Operator

```
lengthof(variable)
```

This operator returns the length, in bits, of the quantity contained in parentheses. The length is the number of bits that was most recently used to parse the quantity at hand. A return value of 0 means that no bits were parsed for this variable.

14.8 Scoping Rules

All parsable variables have class scope, i.e., they are available as class member variables.

For non-parsable variables, the usual C++/Java scoping rules are followed (a new scope is introduced by curly braces: '{' and '}'). In particular, only variables declared in class scope are considered class member variables, and are thus available in objects of that particular type.

15 Profiles

15.1 Introduction

This clause defines profiles and levels for the usage of the tools defined in this part of ISO/IEC 14496. Each profile at a given level constitutes a subset of this part of ISO/IEC 14496 to which system manufacturers and content creators can claim conformance in order to ensure interoperability.

The object descriptor profiles (OD profiles) specify the allowed configurations of the object descriptor tool and the sync layer tool. The scene graph profiles specify the allowed scene graph elements of the BIFS tool. The graphics profiles specify the graphics elements of the BIFS tool that are allowed. The MPEG-J profiles specify the packages of the MPEG-J API specification that are allowed in an MPEG-J terminal.

Profile definitions, by themselves, are not sufficient to provide a full characterization of a receiving terminal's capabilities and the resources needed for a presentation. For this reason, levels are defined within each profile. Levels constrain the values of parameters in a given profile in order to specify an upper complexity bound.

15.2 OD Profile Definitions

15.2.1 Overview

The object descriptor profiles (OD profiles) specify the configurations of the object descriptor tool and the sync layer tool that are allowed. The object descriptor tool provides a structure for all descriptive information. The sync layer tool provides the syntax to convey, among others, timing information for elementary streams. Object descriptor profiles are used, in particular, to reduce the amount of asynchronous operations as well as the amount of permanent storage.

15.2.2 OD Profiles Tools

The following tools are available to construct OD profiles:

- Object descriptor (OD) tool as defined in 8.5.
- Sync layer (SL) tool as defined in 10.2.
- Object content information (OCI) tool as defined in 8.4.
- Intellectual property management and protection (IPMP) tool as defined in 8.3.

15.2.3 OD Profiles

The OD profiles are defined in the following table. Currently, only one profile is defined, comprising all the tools. No additional profiles are foreseen at the moment, but the possibility of adding Profiles through amendments is left open.

Table 58 - OD Profiles

| OD Profiles | |
|--------------------|-------------|
| OD Tools | Core |
| SL | X |
| OD | X |
| OCI | X |
| IPMP | X |

Decoders that claim compliance to a given profile shall implement all the tools with an 'X' entry for that profile.

15.2.4 OD Profiles@Levels

15.2.4.1 Levels for the Core Profile

No levels are defined yet for the OD Core profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.3 Scene Graph Profile Definitions

15.3.1 Overview

The scene graph profiles specify the scene graph elements of the BIFS tool that are allowed. These elements provide the means to describe the spatio-temporal locations, the hierarchical dependencies as well as the behaviors of audio-visual objects in a scene. Profiling of scene graph elements of the BIFS tool serves to restrict the memory requirements and computational complexities of scene graph traversal and processing of specified behaviors during the composition and rendering processes.

15.3.2 Scene Graph Profiles Tools

The following tools are available to construct the definitions for scene graph profiles:

- BIFS nodes related to scene description as defined in Table 59.
- BIFS commands and BIFS animation as defined in 9.3.6 and 0, respectively.
- BIFS ROUTES as defined in 9.3.7.47.1.

15.3.3 Scene Graph Profiles

The following table defines the scene graph profiles:

Table 59 - Scene graph profiles

| Scene Graph Tools | Scene Graph Profiles | | | |
|--------------------------|-----------------------------|------------------|--------------------|-----------------|
| | Audio | Simple 2D | Complete 2D | Complete |
| Anchor | | | X | X |
| AudioBuffer | X | | X | X |
| AudioDelay | X | | X | X |
| AudioFX | X | | X | X |
| AudioMix | X | | X | X |
| AudioSwitch | X | | X | X |
| Billboard | | | | X |
| Collision | | | | X |
| Composite2DTexture | | | X | X |
| Composite3DTexture | | | | X |
| Form | | | X | X |
| Group | X | X | X | X |
| Inline | | | X | X |
| Layer2D | | | X | X |
| Layer3D | | | | X |
| Layout | | | X | X |
| ListeningPoint | | | X | X |
| LOD | | | | X |
| NavigationInfo | | | | X |
| OrderedGroup | | X | X | X |
| QuantizationParameter | | | X | X |
| Sound | | | | X |
| Sound2D | X | X | X | X |
| Switch | | | X | X |
| Transform | | | | X |
| Transform2D | | X | X | X |
| Viewpoint | | | | X |
| WorldInfo | | | X | X |
| Node Update | | | X | X |
| Route Update | | | X | X |
| Scene Update | X | X | X | X |
| AnimationStream | | | X | X |
| Script | | | ? | X |
| ColorInterpolator | | | X | X |
| Conditional | | | X | X |
| CoordinateInterpolator2D | | | X | X |
| CoordinateInterpolator | | | | X |

| | | | | |
|-------------------------|--|--|---|---|
| CylinderSensor | | | | X |
| DiscSensor | | | X | X |
| NormalInterpolator | | | | X |
| OrientationInterpolator | | | | X |
| PlaneSensor2D | | | X | X |
| PlaneSensor | | | | X |
| PositionInterpolator | | | | X |
| PositionInterpolator2D | | | X | X |
| ProximitySensor | | | | X |
| ProximitySensor2D | | | X | X |
| ROUTE | | | X | X |
| ScalarInterpolator | | | X | X |
| SphereSensor | | | | X |
| TermCap | | | X | X |
| TimeSensor | | | X | X |
| TouchSensor | | | X | X |
| VisibilitySensor | | | | X |
| Valuator | | | X | X |

Decoders that claim compliance to a given profile shall implement all the tools with an 'X' entry for that profile.

15.3.3.1 BIFS nodes for audio objects

The presence of AudioClip and AudioSource nodes in BIFS scene graph depends on the selected Audio profile. The following table describes what nodes are allowed in the BIFS scene graph depending on the Audio profile.

Table 60 - BIFS nodes for audio objects

| Audio Profiles | Allowed Audio Object Nodes |
|--------------------|----------------------------|
| Main | AudioClip, AudioSource |
| Scalable | AudioClip, AudioSource |
| Speech | AudioClip, AudioSource |
| Low Rate Synthesis | AudioClip, AudioSource |

15.3.3.2 BIFS nodes for visual objects

The presence of ImageTexture, Background2D, Background, MovieTexture, Face, Expression, FAP, FDP, FIT, FaceDefMesh, FaceDefTable, FaceDefTransform, Viseme nodes in a BIFS scene graph depends on the selected Visual profile. The following table describes what nodes are allowed in the BIFS scene graph depending on the choice of the Visual profile.

Table 61 - BIFS nodes for visual objects

| Visual Profiles | Allowed visual object nodes |
|-----------------|--|
| Simple | ImageTexture, Background2D, Background, MovieTexture |
| Simple Scalable | ImageTexture, Background2D, Background, MovieTexture |
| Core | ImageTexture, Background2D, Background, MovieTexture |
| Main | ImageTexture, Background2D, Background, MovieTexture |
| Simple Scalable | ImageTexture, Background2D, Background, MovieTexture |
| N-Bit | ImageTexture, Background2D, Background, MovieTexture |
| Hybrid | ImageTexture, Background2D, Background, MovieTexture, Face, Expression, FAP, FDP, FIT, FaceDefMesh, FaceDefTable, FaceDefTransform, Viseme |

| | |
|------------------------|--|
| Basic Animated Texture | ImageTexture, Background2D, Background, Face, Expression, FAP, FDP, FIT, FaceDefMesh, FaceDefTable, FaceDefTransform, Viseme |
| Scaleable Texture | ImageTexture, Background2D, Background |
| Simple Face | Face, Expression, FAP, FDP, FIT, FaceDefMesh, FaceDefTable, FaceDefTransform, Viseme |

If the terminal complies with a 2D graphics profile only, the terminal may choose to ignore the contents of the FDP, FIT, FaceDefMesh, FaceDefTable, FaceDefTransform nodes.

15.3.4 Scene Graph Profiles@Levels

15.3.4.1 Levels for the Audio Scene Graph Profile

15.3.4.1.1 Functionalities provided

The Audio scene graph profile provides for a set of BIFS scene graph elements for usage in audio only applications. The Audio scene graph profile supports applications like broadcast radio.

15.3.4.1.2 Levels

No levels are yet defined for the Audio scene graph profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.3.4.2 Levels for the Simple 2D Scene Graph Profile

15.3.4.2.1 Functionalities provided

The Simple 2D scene graph profile provides for only those BIFS scene graph elements necessary to place one or more audio-visual objects in a scene. The Simple 2D scene graph profile allows presentation of audio-visual content with potential update of the complete scene but no interaction capabilities. The Simple 2D scene graph profile supports applications like broadcast television.

15.3.4.2.2 Level 1

The following restrictions apply for the Simple 2D scene graph profile at Level 1:

Table 62 - Restrictions for Simple 2D scene graph profile at Level 1

| Transform2D | |
|-------------------------------------|---------|
| Field name | |
| addChildren | Ignored |
| removeChildren | Ignored |
| children | X. |
| center | Ignored |
| rotationAngle | 0 |
| scale | 1, 1 |
| scaleOrientation | 0 |
| translation | X |
| X = allowed; else: default value | |

The metric shall be the pixel metrics. BIFSConfig.isPixel=1.

A cascade of Transform2D nodes is not allowed. Children nodes of a Transform2D node shall not be Transform2D nodes. Only one initial update to convey the complete scene graph is allowed.

15.3.4.3 Levels for the Complete 2D Scene Graph Profile

15.3.4.3.1 Functionalities provided

The Complete 2D scene graph profile provides for all the 2D scene description elements of the BIFS tool. It supports features such as 2D transformations and alpha blending. The Complete 2D scene graph profile enables 2D applications that require extensive and customized interactivity.

15.3.4.3.2 Levels

No levels are yet defined for the Complete 2D scene graph profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.3.4.4 Levels for the Complete Scene Graph Profile

15.3.4.4.1 Functionalities provided

The Complete scene graph profile provides the complete set of scene graph elements of the BIFS tool. The Complete scene graph profile will enable applications like dynamic virtual 3D world and games.

15.3.4.4.2 Levels

No levels are yet defined for the Complete scene graph profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.4 Graphics Profile Definitions

15.4.1 Overview

The graphics profiles specify the graphics elements of the BIFS tool that are allowed. These elements provide means to represent graphics visual objects in a scene. Profiling of graphics elements of the BIFS tool serves to restrict the memory requirements for the storage of the graphical elements as well as to restrict the computational complexities of composition and rendering processes.

15.4.2 Graphics Profiles Tools

The following tools are available to construct the graphics profiles:

- BIFS nodes related to graphics as defined in Table 63.

15.4.3 Graphics Profiles

The following table defines the graphics profiles:

Table 63 - Graphics profiles

| Graphics Tools | Graphics Profiles | | |
|-----------------------|--------------------------|--------------------|-----------------|
| | Simple 2D | Complete 2D | Complete |
| Appearance | X | X | X |
| Box | | | X |
| Bitmap | X | X | X |
| Background | | | X |
| Background2D | | X | X |
| Circle | | X | X |
| Color | | X | X |
| Cone | | | X |
| Coordinate | | | X |
| Coordinate2D | | X | X |
| Curve2D | | X | X |
| Cylinder | | | X |

| | | | |
|-------------------|---|---|---|
| DirectionalLight | | | X |
| ElevationGrid | | | X |
| Expression | | | X |
| Extrusion | | | X |
| Face | | | X |
| FaceDefMesh | | | X |
| FaceDefTable | | | X |
| FaceDefTransform | | | X |
| FAP | | | X |
| FDP | | | X |
| FIT | | | X |
| Fog | | | X |
| FontStyle | | X | X |
| IndexedFaceSet | | | X |
| IndexedFaceSet2D | | X | X |
| IndexedLineSet | | | X |
| IndexedLineSet2D | | X | X |
| LineProperties | | X | X |
| Material | | | X |
| Material2D | | X | X |
| Normal | | | X |
| PixelTexture | | X | X |
| PointLight | | | X |
| PointSet | | | X |
| PointSet2D | | X | X |
| Rectangle | | X | X |
| Shape | X | X | X |
| Sphere | | | X |
| SpotLight | | | X |
| Text | | X | X |
| TextureCoordinate | | X | X |
| TextureTransform | | X | X |
| Viseme | | | X |

Decoders that claim compliance to a given profile shall implement all the tools with an 'X' entry for that profile.

15.4.4 Graphics Profiles@Levels

15.4.4.1 Levels for the Simple 2D Graphics Profile

15.4.4.1.1 Functionalities provided

The Simple 2D graphics profile provides for only those graphics elements of the BIFS tool that are necessary to place one or more visual objects in a scene.

15.4.4.1.2 Levels

No levels are yet defined for the Simple 2D graphics profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.4.4.2 Levels for the Complete 2D Graphics Profile

15.4.4.2.1 Provided functionality

The Complete 2D graphics profile provides two-dimensional graphics functionalities and supports features such as arbitrary two-dimensional graphics and text, possibly in conjunction with visual objects.

15.4.4.2.2 Levels

No levels are yet defined for the Complete 2D graphics profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.4.4.3 Levels for the Complete Graphics Profile

15.4.4.3.1 Provided functionality

The Complete graphics profile provides advanced graphical elements such as elevation grids and extrusions and allows creating content with sophisticated lighting. The Complete Graphics profile enables applications such as complex virtual worlds that exhibit a high degree of realism.

15.4.4.3.2 Levels

No levels are yet defined for the Complete Graphics profile. Future definition of Levels is anticipated; this will happen by means of an amendment to this part of the standard.

15.5 MPEG-J Profile Definitions

15.5.1 Overview

MPEG-J specifies the format, delivery, and behavior of downloadable byte code on MPEG-4 terminals. This enables content owners to embed complex control algorithms with the data. MPEG-J applications, however, can be local or remote (MPEGlet). These applications use a specified set of Java APIs.

15.6 MPEG-J Profiles Tools

The following API packages are available to construct MPEG-J profiles:

- Scene APIs (package org.iso.mpeg.mpegj.scene) as defined in 11.5.3.
- Resource APIs (package org.iso.mpeg.mpegj.resource) as defined in 11.5.4.
- Net APIs (package org.iso.mpeg.mpegj.net) as defined in 11.5.6.
- Decoder APIs (package org.iso.mpeg.mpegj.decoder) as defined in 11.5.5.
- Section Filtering and Service Information as defined in 11.5.7.
- Please note that the package org.iso.mpeg.mpegj is required in all terminals.

15.7 MPEG-J Profiles

The MPEG-J profiles are defined in Table 64. Currently, there are two profiles defined, comprising all the API packages.

The Personal profile addresses a range of constrained devices ranging from mobile and portable devices up to personal computers. Examples of such devices are cell videophones, PDAs, personal gaming devices, multimedia computers, etc.

The Main profile is a superset of Personal profile and it addresses the broadcast oriented devices including entertainment devices. Examples of such devices are set top boxes, digital TVs, etc.

Table 64 - MPEG-J Profiles

| MPEG-J Packages | MPEG-J Profiles | |
|------------------------|------------------------|-------------|
| | Personal | Main |
| Scene | X | X |
| Resource | X | X |
| Decoder | X | X |
| Net | X | X |
| SI/SF | | X |

- Decoders that claim compliance to a given profile shall implement all the packages with an 'X' entry for that profile and the org.iso.mpeg.mpegj package (required for all profiles).

15.8 MPEG-J Profiles@Levels

15.8.1 Levels for the Personal MPEG-J Profile

No levels are defined yet for the MPEG-J Personal profile. No Levels are foreseen at the moment, but the possibility of adding Levels through amendments is left open.

15.8.2 Levels for the Main MPEG-J Profile

No levels are defined yet for the MPEG-J Main profile. No Levels are foreseen at the moment, but the possibility of adding Levels through amendments is left open.

Annex A
(informative)**Bibliography**

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Annex B (informative)

Time Base Reconstruction

B.1 Time Base Reconstruction

The time stamps present in the sync layer are the means to synchronize events related to decoding, composition and overall buffer management. In particular, the clock references are the sole means of reconstructing the sending terminal's clock at the receiving terminal, when required (e.g., for broadcast applications). A normative method for this reconstruction is not specified. The following describes the process at a conceptual level.

B.1.1 Adjusting the Receiving Terminal's OTB

Each elementary stream may be generated by an encoder at the sending terminal with a different object time base (OTB). For each stream that conveys OCR information, it is possible for the receiving terminal to adjust a local OTB to the sending terminals' OTB. This is done by using well-known PLL techniques. The notion of time for each data stream can therefore be recovered at the receiving end.

B.1.2 Mapping Time Stamps to the STB

The OTBs of all data streams may run at a different speed than the STB of the receiving terminal. Therefore, a method is needed to map the value of time stamps expressed in any OTB to the STB of the receiving terminal. This step may be done jointly with the recovery of individual OTB's as described in the previous subclause.

Note that the receiving terminals' system time base need not be locked to any of the available object time bases.

The composition time t_{SCT} of a composition unit, expressed in terms of STB of the receiving terminal, can be calculated from the composition time stamp value t_{OCT} , expressed in terms of the OTB of the relevant sending terminal, by a linear transformation:

$$t_{SCT} = \frac{\Delta t_{STB}}{\Delta t_{OTB}} \cdot t_{OCT} - \frac{\Delta t_{STB}}{\Delta t_{OTB}} \cdot t_{OTB-START} + t_{STB-START}$$

with:

| | |
|-----------------|---|
| t_{SCT} | composition time of a composition unit measured in units of t_{STB} |
| t_{STB} | current time in the receiving terminal's STB |
| t_{OCT} | composition time of a composition unit measured in units of t_{OTB} |
| t_{OTB} | current time in the data stream's OTB, conveyed by an OCR |
| $t_{STB-START}$ | value of receiving terminal's STB when the first byte of the OCR time stamp of the data stream is encountered |
| $t_{OTB-START}$ | value of the first OCR time stamp of the data stream |

$$\Delta t_{OTB} = t_{OTB} - t_{OTB-START}$$

$$\Delta t_{STB} = t_{STB} - t_{STB-START}$$

The quotient $\Delta t_{STB}/\Delta t_{OTB}$ is the instantaneous scaling factor between the two time bases. In cases where the clock speed and resolution of the sending terminal and of the receiving terminal are nominally identical, this quotient is very near 1. To avoid long term rounding errors, the quotient $\Delta t_{STB}/\Delta t_{OTB}$ should always be recalculated whenever the formula is applied to a newly received composition time stamp. The quotient can be updated each time an OCR time stamp is encountered.

A similar formula can be derived for decoding times by replacing composition time stamps with decoding time stamps. If time stamps for some access units or composition units are only known implicitly, e.g., given by known update rates, these have to be mapped with the same mechanism.

With this procedure it is possible to synchronize the STB at a receiving terminal to several OTBs so that correct decoding and composition from several data streams is possible.

B.1.3 Adjusting the STB to an OTB

When all data streams in a presentation use the same OTB, it is possible to lock the STB at the receiving terminal to this OTB using well-known PLL techniques. In this case the mapping described in the previous subclause is not necessary and the following mapping may be used.

$$t_{STB-START} = t_{OTB-START}$$

$$\Delta t_{STB} = \Delta t_{OTB}$$

$$t_{SCT} = t_{OCT}$$

B.1.4 System Operation without Object Time Base

If a time base for an elementary stream is neither conveyed by OCR information nor derived from another elementary stream, time stamps can still be used by a receiving terminal but not in applications that require flow-control. For example, file-based playback may not require time base reconstruction: time stamps alone are sufficient for synchronization if a single time base is assumed for all the data streams.

In the absence of time stamps, the receiving terminal may only operate under the assumption that each access unit is to be decoded and presented as soon as it is received. In this case the systems decoder model does not apply and cannot be used as a model for the terminal's behavior.

In the case that a universal clock is available which can be shared between peer terminals, it may be used as a common time base. It is then possible to use the systems decoder model without explicit OCR transmission. The procedures for doing so are application-dependent and are not defined in ISO/IEC 14496-1.

B.2 Temporal aliasing and audio resampling

A receiving terminal compliant with ISO/IEC 14496 is not required to synchronize decoding of AUs and composition of CUs. In other words, its STB does not have to be identical to any of the OTBs of received data streams. The number of decoded and actually presented (displayed/played back) units per second may therefore differ. Temporal aliasing may then manifest itself as composition units being either presented multiple times or skipped.

If audio signals are encoded on a system with an OTB different from the STB of the receiving terminal, even nominally identical sampling rates of the audio samples may not match exactly, so that audio samples may be dropped or repeated.

Proper re-sampling techniques may of course in both cases be applied at the receiving terminal.

B.3 Reconstruction of a Synchronised Audio-visual Scene: A Walkthrough

The different steps to reconstruct a synchronized scene are as follows:

1. The time base for each data stream is recovered either from the OCR conveyed with the SL-packetized elementary stream of this data stream or from another data stream present in the presentation.
2. Object time stamps are mapped to the STB of the receiving terminal according to a suitable algorithm (e.g., the one detailed above).
3. Received access units are placed in the decoding buffer.

4. Each access unit is instantaneously decoded by the decoder at instants of time (in terms of the receiver terminal's STB) corresponding to its implicit or explicit DTS and the resulting one or more composition units are placed in the composition memory.
5. The compositor may access each CU at time instants between the one corresponding its CTS and the one corresponding to the CTS of the subsequent CU.

Annex C (normative)

View Dependent Object Scalability

C.1 Introduction

Coding of View-Dependent Scalability (VDS) parameters for texture can provide for efficient incremental decoding of 3D images (e.g. 2D texture mapped onto a 3D mesh such as terrain). Corresponding tools from the Visual and Systems parts of this specification (ISO/IEC 14496-2 and ISO/IEC 14496-1, respectively) are used in conjunction with downstream and upstream channels of a receiving terminal. The combined capabilities provide the means for a sending terminal to react to a stream of viewpoint information received from a receiving terminal. The sending terminal transmits a series of coded textures optimized for the viewing conditions, which can be applied to the rendering of, textured 3D meshes by the receiving terminal. Each encoded view-dependent texture (initial texture and incremental updates) typically corresponds to a specific 3D view in the user's viewpoint that is first transmitted from the receiving terminal.

A Systems tool transmits 3D viewpoint parameters in the upstream channel back to the sending terminal. The encoder's response is a frequency-selective, view-dependent update of DCT coefficients for the 2D texture (based upon view-dependent projection of the 2D texture in 3D) back to the receiving terminal, via the downstream channel, for decoding by a Visual DCT tool at the receiving terminal. This bilateral communication supports interactive server-based refinement of texture for low-bandwidth transmissions to a receiving terminal that renders the texture in 3D for a user controlling the viewpoint movement. A gain in texture transmission efficiency is traded for longer closed-loop latency in the rendering of the textures in 3D. The receiving terminal coordinates inbound texture updates with local 3D renderings, accounting for network delays so that texture cached in the terminal matches each rendered 3D view.

A method to obtain an optimal coding of 3D data is to take into account the viewing position in order to transmit only the most visible information. This approach reduces greatly the transmission delay, in comparison to transmitting all scene texture that might be viewable in 3D from the sending terminal's database server to the receiving terminal. At a given time, only the most important information is sent, depending on object geometry and viewpoint displacement. This technique allows the data to be streamed across a network, given that a upstream channel is available for sending the new viewing conditions to the remote database. This principle is applied to the texture data to be mapped on a 3D grid mesh. The mesh is first downloaded into the memory of the receiving terminal using the appropriate BIFS node, and then the DCT coefficients of the texture image are updated by taking into account the viewing parameters, i.e. the field of view, the distance and the direction to the viewpoint.

C.2 Bitstream Syntax

This subclause details the bitstream syntax for the upstream data and details the rules that govern the way in which higher level syntactic elements may be combined together to generate a compliant bitstream that can be decoded correctly by the receiving terminal.

C.3.1 specifies the bitstream syntax for a View Dependent Object which initializes the session at the upstream data decoder. C.3.2 specifies the View Dependent Object Layer and contains the viewpoint information that is to be communicated back to the texture data encoder in the sending terminal.

C.2.1 View Dependent Object

```
class ViewDependentObject {
    unsigned int (32) View_dep_object_start_code;
    unsigned int (16) Field_of_View;
    bit (1) Marker_bit;
    unsigned int (16) Xsize_of_rendering_window;
    bit (1) Marker_bit;
    unsigned int (16) Ysize_of_rendering_window
    bit (1) Marker_bit;
    unsigned int (32)* NextStartCode;
    while (NextStartCode == view_dep_object_layer_start_code){
        ViewDependentObjectLayer vdol;
        unsigned int (32)* NextStartCode;
```

```

        }
    }

class ViewDependentObjectLayer() {
    unsigned int (32) View_dep_object_layer_start_code;
    unsigned int (16) Xpos1 ;
    bit (1) Marker_bit;
    unsigned int (16) Xpos2;
    bit (1) Marker_bit;
    unsigned int (16) Ypos1;
    bit (1)Marker_bit;
    unsigned int (16) Ypos2;
    bit (1) Marker_bit;
    unsigned int (16) Zpos1;
    bit (1) Marker_bit;
    unsigned int (16) Zpos2;
    bit (1) Marker_bit;
    unsigned int (16) Xaim1;
    bit (1) Marker_bit;
    unsigned int (16) Xaim2;
    bit (1) Marker_bit;
    unsigned int (16) Yaim1;
    bit (1) Marker_bit;
    unsigned int (16) Yaim2;
    bit (1) Marker_bit;
    unsigned int (16) Zaim1;
    bit (1) Marker_bit;
    unsigned int (16) Zaim2;
}

```

C.3 Bitstream Semantics

C.3.1 View Dependent Object

view_dep_object_start_code: The view_dep_object_start_code is the string ‘000001BF’ in hexadecimal. It initiates a view dependent object session.

field_of_view: This is a 16-bit unsigned integer that specifies the field of view.

marker bit: This is a one bit field, set to ‘1’, to prevent start code emulation within the bitstream.

xsize_of_rendering_window: This is a 16-bit unsigned integer that specifies the horizontal size of the rendering window.

ysize_of_rendering_window: This is a 16-bit unsigned integer that specifies the vertical size of the rendering window.

C.3.2 View Dependent Object Layer

view_dep_object_layer_start_code: The view_dep_object_layer_start_code is the bit string ‘000001BE’ in hexadecimal. It initiates a view dependent object layer.

xpos1: This is a 16-bit codeword which forms the lower 16 bits of the 32-bit integer xpos. The integer xpos is to be computed as follows: $xpos = xpos1 + (xpos2 \ll 16)$. The quantities xpos, ypos, zpos describe the 3D coordinates of the viewer's position.

xpos2: This is a 16-bit codeword which forms the upper 16-bit word of the 32-bit integer xpos.

ypos1: This is a 16-bit codeword which forms the lower 16-bit word of the 32-bit integer ypos. The integer ypos can be computed as follows: $ypos = ypos1 + (ypos2 \ll 16)$.

ypos2: This is a 16-bit codeword which forms the upper 16bit word of the 32-bit integer xpos.

zpos1: This is a 16-bit codeword which forms the lower 16 bits of the 32-bit integer xpos. The integer zpos can be computed as follows: $zpos = zpos1 + (zpos2 \ll 16)$.

zpos2: This is a 16-bit codeword which forms the upper 16 bits of the 32-bit integer xpos.

xaim1 – This is a 16-bit codeword which forms the lower 16 bits of the 32-bit integer xaim. The integer xaim can be computed as follows: $xaim = xaim1 + (xaim2 \ll 16)$. The quantities xaim, yaim, zaim describe the 3D position of the aim point.

xaim2: This is a 16-bit codeword which forms the upper 16 bits of the 32-bit integer xaim.

yaim1: This is a 16-bit codeword which forms the lower 16 bits of the 32-bit integer yaim. The integer yaim can be computed as follows: $yaim = yaim1 + (yaim2 \ll 16)$.

yaim2: This is a 16-bit codeword which forms the upper 16 bits of the 32-bit integer yaim.

zaim1: This is a 16-bit codeword which forms the lower 16 bits of the 32-bit integer zaim. The integer zaim can be computed as follows: $zaim = zaim1 + (zaim2 \ll 16)$.

zaim2: This is a 16-bit codeword which forms the upper 16 bits of the 32-bit integer zaim.

Annex D (informative)

Registration procedure

D.1 Procedure for the request of a Registration ID (RID)

Requesters of a RID shall apply to the Registration Authority. Registration forms shall be available from the Registration Authority. The requester shall provide the information specified in D.3. Companies and organizations are eligible to apply.

D.2 Responsibilities of the Registration Authority

The primary responsibilities of the Registration Authority administrating the registration of either the private data format identifiers or the IPMP system type values are outlined in this annex; certain other responsibilities may be found in the JTC 1 Directives. The Registration Authority shall:

- a) implement a registration procedure for application for a unique RID in accordance with the JTC 1 Directives;
- b) receive and process the applications for allocation of an identifier from application providers;
- c) ascertain which applications received are in accordance with this registration procedure, and to inform the requester within 30 days of receipt of the application of their assigned RID;
- d) inform application providers whose request is denied in writing with 30 days of receipt of the application, and to consider resubmissions of the application in a timely manner;
- e) maintain an accurate register of the allocated identifiers. Revisions to format specifications shall be accepted and maintained by the Registration Authority;
- f) make the contents of this register available upon request to National Bodies of JTC 1 that are members of ISO or IEC, to liaison organizations of ISO or IEC and to any interested party;
- g) maintain a data base of RID request forms, granted and denied. Parties seeking technical information on the format of private data which has a RID shall have access to such information which is part of the data base maintained by the Registration Authority.;
- h) report its activities annually to JTC 1, the ITTF, and the SC 29 Secretariat, or their respective designees; and
- i) accommodate the use of existing RIDs whenever possible.

D.3 Contact information for the Registration Authority

To Be Determined

D.4 Responsibilities of Parties Requesting a RID

The party requesting a format identifier or an IPMP system type identifier shall:

- a) apply using the Form and procedures supplied by the Registration Authority;
- b) include a description of the purpose of the registered bitstream, and the required technical details as specified in the application form;
- c) provide contact information describing how a complete description can be obtained on a non-discriminatory basis;

- d) agree to institute the intended use of the granted RID within a reasonable time frame; and
- e) to maintain a permanent record of the application form and the notification received from the Registration Authority of a granted RID.

D.5 Appeal Procedure for Denied Applications

The Registration Management Group is formed to have jurisdiction over appeals to denied request for a RID. The RMG shall have a membership who is nominated by P- and L-members of the ISO technical committee responsible for ISO/IEC 14496. It shall have a convenor and secretariat nominated from its members. The Registration Authority is entitled to nominate one non-voting observing member.

The responsibilities of the RMG shall be:

- a) to review and act on all appeals within a reasonable time frame;
- b) to inform, in writing, organizations which make an appeal for reconsideration of its petition of the RMGs disposition of the matter;
- c) to review the annual report of the Registration Authorities summary of activities; and
- d) to supply Member Bodies of ISO and National Committees of IEC with information concerning the scope of operation of the Registration Authority.

D.6 Registration Application Form

D.6.1 Contact Information of organization requesting a RID

Organization Name:

Address:

Telephone:

Fax:

E-mail:

Telex:

D.6.2 Request for a specific RID

NOTE — If the system has already been implemented and is in use, fill in this item and item D.6.3 and skip to D.6.5, otherwise leave this space blank and skip to D.6.3)

D.6.3 Short description of RID that is in use and date system was implemented

D.6.4 Statement of an intention to apply the assigned RID

D.6.5 Date of intended implementation of the RID

D.6.6 Authorized representative

Name:

Title:

Address:

Email:

Signature _____

D.6.7 For official use of the Registration Authority

Registration Rejected _____

Reason for rejection of the application:

Registration Granted _____

Registration Value _____

Attachment 1 — Attachment of technical details of the registered data format.

Attachment 2 — Attachment of notification of appeal procedure for rejected applications.

Annex E (informative)

The QoS Management Model for ISO/IEC 14496 Content

The Quality of Service (QoS) aspects deserve particular attention in ISO/IEC 14496: the ability of the standard to adapt to different service scenarios is affected by its ability to consistently manage QoS requirements. Current techniques on error resilience are already effective, but are not and will not be able to satisfy every possible requirement.

In general terms, the end-user acceptance of a particular service varies depending on the kind of service. As an example, person to person communication is severely affected by the audio quality, while it can tolerate variations in the video quality. However, a television broadcast with higher video and lower audio quality may be acceptable depending on the program being transmitted. The acceptability of a particular service thus depends very much on the service itself. It is not possible to define universal Quality of Service levels that may be suitable for all circumstances. Thus the most suitable solution is to let the content creator decide what QoS the end-user should obtain for every particular elementary stream: the author has the best knowledge of the service.

The QoS so defined represents the QoS that should be offered to the end-user, i.e., the QoS at the output of the receiving terminal. This may be the output of the decoder, but may also take into account the compositor and renderer if they significantly impact the QoS of the presentation as seen by the end-user, and if a capacity for processing a specific stream can be quantified. Note that the QoS information is not mandatory. In the absence of QoS requirements, a best effort approach should be pursued. This QoS concept is defined as *total QoS*.

In ISO/IEC 14496-1 the information concerning the total QoS of a particular elementary stream is carried in a QoS Descriptor as part of its elementary stream descriptor (ES_Descriptor). The receiving terminal, upon reception of the ES_Descriptor, is therefore aware of the characteristics of the elementary stream and of the total QoS to be offered to the end-user. Moreover the receiving terminal knows about its own performance capabilities. It is therefore the only possible entity able to compute the Quality of Service to be requested to the delivery layer in order to fit the user requirements. Note that this computation could also ignore/override the total QoS parameters.

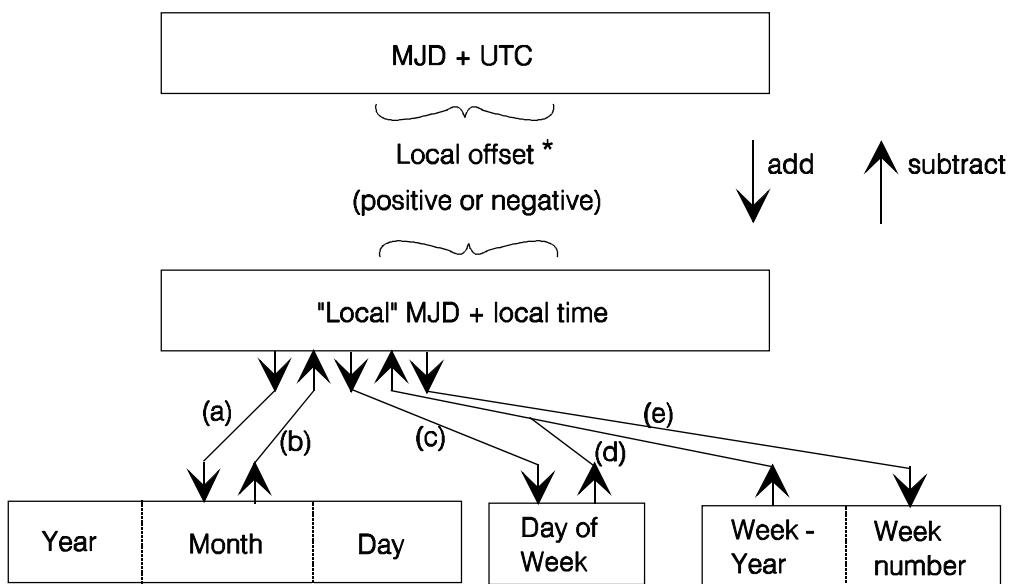
The QoS that is requested to the delivery layer is named *media QoS*, since it is expressed with a semantic which is media oriented. The delivery layer will process the requests, determine whether to bundle multiple elementary streams into a single network connection (TransMux) and compute the QoS for the network connection, using the QoS parameters as defined by the network infrastructure. This QoS concept is named *network QoS*, since it is specific for a particular network technology.

The above categorization of the various QoS concepts managed in ISO/IEC 14496 may suggest that this issue is only relevant when operating in a network environment. However the concepts are of general value, and are applicable to systems operating on local files as well, when taking into account the overall capacity of the system.

Annex F (informative)

Conversion Between Time and Date Conventions

The types of conversions that may be required are summarized in the diagram below.



* Offsets are positive for Longitudes East of Greenwich and negative for longitudes West of Greenwich.

Figure 38 - Conversion routes between Modified Julian Date (MJD) and Coordinated Universal Time (UTC)

The conversion between MJD + UTC and the "local" MJD + local time is simply a matter of adding or subtracting the local offset. This process may, of course, involve a "carry" or "borrow" from the UTC affecting the MJD. The other five conversion routes shown on the diagram are detailed in the formulas below.

Symbols used:

| | |
|-------------------|---|
| MJD: | Modified Julian Day |
| UTC: | Co-ordinated Universal Time |
| Y: | Year from 1900 (e.g. for 2003, Y = 103) |
| M: | Month from January (= 1) to December (= 12) |
| D: | Day of month from 1 to 31 |
| WY: | "Week number" Year from 1900 |
| MN: | Week number according to ISO 2015 |
| WD: | Day of week from Monday (= 1) to Sunday (= 7) |
| K, L ,M' , W, Y': | Intermediate variables |
| ×: | Multiplication |
| int: | Integer part, ignoring remainder |
| mod 7: | Remainder (0-6) after dividing integer by 7 |

- a) To find Y, M, D from MJD

$$\begin{aligned}
 Y' &= \text{int} [(\text{MJD} - 15\,078,2) / 365,25] \\
 M' &= \text{int} \{ [\text{MJD} - 14\,956,1 - \text{int}(Y' \times 365,25)] / 30,6001 \} \\
 D &= \text{MJD} - 14\,956 - \text{int}(Y' \times 365,25) - \text{int}(M' \times 30,6001) \\
 \text{If } M' = 14 \text{ or } M' = 15, \text{ then } K = 1; \text{ else } K = 0
 \end{aligned}$$

$$Y = Y' + K$$

$$M = M' - 1 - K \times 12$$

- b) To find MJD from Y, M, D

If $M = 1$ or $M = 2$, then $L = 1$; else $L = 0$

$$MJD = 14\,956 + D + \text{int} [(Y - L) \times 365,25] + \text{int} [(M + 1 + L \times 12) \times 30,6001]$$

- c) To find WD from WJD

$$WD = [(MJD + 2) \bmod 7] + 1$$

- d) To find MJD from WY, WN, WD

$$MJD = 15\,012 + WD + 7 \times \{ WN + \text{int} [(WY \times 1\,461 / 28) + 0,41] \}$$

- e) To find WY, WN from MJD

$$W = \text{int} [(MJD / 7) - 2\,144,64]$$

$$WY = \text{int} [(W \times 28 / 1\,461) - 0,0079]$$

$$WN = W - \text{int} [(WY \times 1\,461 / 28) + 0,41]$$

EXAMPLE —

| | | | | | |
|-----|---|---------------|----|---|------------|
| MJD | = | 45 218 | W | = | 4 315 |
| Y | = | (19)82 | WY | = | (19)82 |
| M | = | 9 (September) | WN | = | 36 |
| D | = | 6 | WD | = | 1 (Monday) |

NOTE — These formulas are applicable between the inclusive dates 1 900 March 1 to 2 100 February 28.

Annex G (normative)

Adaptive Arithmetic Decoder for BIFS-Anim

The following procedures, in C code, describe the adaptive arithmetic decoder used in a BIFS-Anim session. The model is specified through the array `int* cumul_freq[]`. The decoded symbol is returned through its index in the model.

First, the following integers are defined :

```
static long bottom=0, q1=2^14, q2=2^15, q3=3*2^14, top=2^16;
```

The decoder is initialized to start decoding an arithmetic coded bitstream by calling the following procedure.

```
static long low, high, code_value, bit, length, sacindex, cum, zerorun=0;

void decoder_reset( )
{
    int i;
    zerorun = 0;           /* clear consecutive zero's counter */
    code_value = 0;
    low = 0;
    high = top;
    for (i = 1; i <= 16; i++) { //16 bits are read ahead
        bit_out_psc_layer();
        code_value = 2 * code_value + bit;
    }
    used_bits = 0;
}
```

In the BIFS-Anim decoding process, a symbol is decoded using a model specified through the array `cumul_freq[]` and by calling the following procedure.

```
static long low, high, code_value, bit, length, sacindex, cum, zerorun=0;

int aa_decode(int cumul_freq[ ])
{
    length = high - low + 1;
    cum = (-1 + (code_value - low + 1) * cumul_freq[0]) / length;
    for (sacindex = 1; cumul_freq[sacindex] > cum; sacindex++);
    high = low - 1 + (length * cumul_freq[sacindex-1]) / cumul_freq[0];
    low += (length * cumul_freq[sacindex]) / cumul_freq[0];

    for ( ; ; ) {
        if (high < q2) ;
        else if (low >= q2) {
            code_value -= q2;
            low -= q2;
            high -= q2;
        }
        else if (low >= q1 && high < q3) {
            code_value -= q1;
            low -= q1;
            high -= q1;
        }
        else {
            break;
        }
        low *= 2;
        high = 2*high + 1;
        bit_out_psc_layer();
        code_value = 2*code_value + bit;
        used_bits++;
    }
    return (sacindex-1);
}
```

```

}

void bit_out_psc_layer()
{
    bit = getbits(1);
    if (zerorun > 22) {
        if (!bit) {
            // Error condition... long zero runs shouldn't occur
        } else {
            bit = getbits(1); // removed startCode previsiton bit
            zerorun = !bit; // if 0, start counting again at zerorun = 1
        }
    } else { // not close to hitting a fake startCode
        if (!bit) {
            ++zerorun;
        } else {
            zerorun = 0;
        }
    }
}

```

The model is specified in the array `cumul_freq[]`. It is reset with the following procedure.

```

void model_reset(int nbBits)
{
    int nbValues = (1<<nbBits)+1;
    int* cumul_freq = (int*) malloc(sizeof(int)*nbValues);
    int i;
    for (i=1;i<=nbValues;i++) {
        cumul_freq[i] = nbValues-i;
    }
}

```

The model is updated when the value `symbol` is read with the following procedure.

```

void update_model(int cumul_freq[ ], int symbol) {
    if (cumul_freq[0] == q1) { //The model is rescaled to avoid overflow
        int cum = 0;
        for(int i=nb_of_symbols-1; i>=0; i--) {
            cum += (cumul_freq[i]-cumul_freq[i+1]+1)/2;
            cumul_freq[i] = cum;
        }
        cumul_freq[nb_of_symbols] = 0;
    }

    while(symbol>0)
        cumul_freq[symbol--]++;
}

```

Annex H

(normative)

Node coding tables

Nodes: [Anchor](#) [AnimationStream](#) [Appearance](#) [AudioBuffer](#) [AudioClip](#) [AudioDelay](#) [AudioFX](#) [AudioMix](#) [AudioSource](#) [AudioSwitch](#) [Background](#) [Background2D](#) [Billboard](#) [Bitmap](#) [Box](#) [Circle](#) [Collision](#) [Color](#) [ColorInterpolator](#) [CompositeTexture2D](#) [CompositeTexture3D](#) [Conditional](#) [Cone](#) [Coordinate](#) [Coordinate2D](#) [CoordinateInterpolator](#) [CoordinateInterpolator2D](#) [Curve2D](#) [Cylinder](#) [CylinderSensor](#) [DirectionalLight](#) [DiscSensor](#) [ElevationGrid](#) [Expression](#) [Extrusion](#) [Face](#) [FaceDefMesh](#) [FaceDefTables](#) [FaceDefTransform](#) [FAP](#) [FDP](#) [FIT](#) [Fog](#) [FontStyle](#) [Form](#) [Group](#) [ImageTexture](#) [IndexedFaceSet](#) [IndexedFaceSet2D](#) [IndexedLineSet](#) [IndexedLineSet2D](#) [Inline](#) [LOD](#) [Layer2D](#) [Layer3D](#) [Layout](#) [LineProperties](#) [ListeningPoint](#) [Material](#) [Material2D](#) [MovieTexture](#) [NavigationInfo](#) [Normal](#) [NormalInterpolator](#) [OrderedGroup](#) [OrientationInterpolator](#) [PixelTexture](#) [PlaneSensor](#) [PlaneSensor2D](#) [PointLight](#) [PointSet](#) [PointSet2D](#) [PositionInterpolator](#) [PositionInterpolator2D](#) [ProximitySensor2D](#) [ProximitySensor](#) [QuantizationParameter](#) [Rectangle](#) [ScalarInterpolator](#) [Script](#) [Shape](#) [Sound](#) [Sound2D](#) [Sphere](#) [SphereSensor](#) [SpotLight](#) [Switch](#) [TermCap](#) [Text](#) [TextureCoordinate](#) [TextureTransform](#) [TimeSensor](#) [TouchSensor](#) [Transform](#) [Transform2D](#) [Valuator](#) [Viewpoint](#) [VisibilitySensor](#) [Viseme](#) [WorldInfo](#)

Node Data Types: [SF2DNode](#) [SF3DNode](#) [SFAppearanceNode](#) [SFAudioNode](#) [SFBackground2DNode](#) [SFBackground3DNode](#) [SFColorNode](#) [SFCoordinate2DNode](#) [SFCoordinateNode](#) [SFExpressionNode](#) [SFFAPNode](#) [SFFDPNode](#) [SFFITNode](#) [SFFaceDefMeshNode](#) [SFFaceDefTablesNode](#) [SFFaceDefTransformNode](#) [SFFogNode](#) [SFFontStyleNode](#) [SGeometryNode](#) [SFLinePropertiesNode](#) [SFMaterialNode](#) [SFNavigationInfoNode](#) [SFNormalNode](#) [SFStreamingNode](#) [SFTextureCoordinateNode](#) [SFTextureNode](#) [SFTextureTransformNode](#) [SFTopNode](#) [SFViewpointNode](#) [SFVisemeNode](#) [SFWorldNode](#)

Extended Nodes: [AcousticMaterial](#) [AcousticScene](#) [ApplicationWindow](#) [BAP](#) [BDP](#) [Body](#) [BodyDefTable](#) [BodySegmentConnectionHint](#) [DirectiveSound](#) [Hierarchical3DMesh](#) [MaterialKey](#) [PerceptualParameters](#)

Extended Node Data Types: [SF2DNode](#) [SF3DNode](#) [SFBAPNode](#) [SFBDPNode](#) [SFBodyDefTableNode](#) [SFBodySegmentConnectionHintNode](#) [SFMaterialNode](#) [SFPerceptualParameterNode](#) [SFWorldNode](#)

H.1 Node Tables

Legend:

| Node Name | | Node Data Type list | | | | | nodeType/NDT | | |
|------------|------------|---------------------|-------|--------|--------|------------|--------------|------------------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [min, max] | Quantizer id | Animation method | |

H.1.1 Anchor

| | | | | | | | | |
|-------------------|-------------------|---------------|--------------|---------------|---------------|---------------|----------|----------|
| Anchor | SFWorldNode | | | | | | 0000001 | |
| | SF3DNode | | | | | | 000001 | |
| | SF2DNode | | | | | | 00001 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF3DNode | | 000 | | | | | |
| removeChildren | MF3DNode | | 001 | | | | | |
| children | MF3DNode | 00 | 010 | 00 | | | | |
| description | SFString | 01 | 011 | 01 | | | | |
| parameter | MFString | 10 | 100 | 10 | | | | |
| url | MFURL | 11 | 101 | 11 | | | | |

H.1.2 AnimationStream

| AnimationStream | SFWorldNode | | | | | | 0000010 | |
|------------------------|-------------------|---------------|--------------|---------------|---------------|---------------|----------|----------|
| | SF3DNode | | | | | | 000010 | |
| | SF2DNode | | | | | | 00010 | |
| | SFStreamingNode | | | | | | 001 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| loop | SFBool | 000 | 000 | 000 | | | | |
| speed | SFFloat | 001 | 001 | 001 | | [-1, +1] | 0 | 7 |
| startTime | SFTime | 010 | 010 | 010 | | [-1, +1] | | |
| stopTime | SFTime | 011 | 011 | 011 | | [-1, +1] | | |
| url | MFURL | 100 | 100 | 100 | | | | |
| duration_changed | SFTime | | | 101 | | | | |
| isActive | SFBool | | | 110 | | | | |

H.1.3 Appearance

| Appearance | SFWorldNode | | | | | | 0000011 | |
|-------------------|-------------------------|---------------|--------------|---------------|---------------|---------------|----------|----------|
| | SFAppearanceNode | | | | | | 1 | |
| | | | | | | | | |
| | | | | | | | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| material | SFMaterialNode | 00 | 00 | 00 | | | | |
| texture | SFTextureNode | 01 | 01 | 01 | | | | |
| textureTransform | SFTextureTransform Node | 10 | 10 | 10 | | | | |

H.1.4 AudioBuffer

| AudioBuffer | SFWorldNode | | | | | | 0000100 | |
|--------------------|-------------------|---------------|--------------|---------------|---------------|---------------|----------|----------|
| | SFAudioNode | | | | | | 001 | |
| | | | | | | | | |
| | | | | | | | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| loop | SFBool | 000 | 000 | 0000 | | | | |
| pitch | SFFloat | 001 | 001 | 0001 | | [0, +1] | 0 | 7 |
| startTime | SFTime | 010 | 010 | 0010 | | [0, +1] | 0 | |
| stopTime | SFTime | 011 | 011 | 0011 | | [0, +1] | 0 | |
| children | MFAudioNode | 100 | 100 | 0100 | | | | |
| numChan | SFInt32 | 101 | 101 | 0101 | | [0, 255] | 13,8 | |
| phaseGroup | MFI32 | 110 | 110 | 0110 | | | | |
| length | SFFloat | 111 | | | | [0, +1] | 0 | |
| duration_changed | SFTime | | | 0111 | | | | |
| isActive | SFBool | | | 1000 | | | | |

H.1.5 AudioClip

| AudioClip | SFWorldNode | | | | | | 0000101 | |
|-------------------|-------------------|---------------|--------------|---------------|---------------|---------------|----------|----------|
| | SFAudioNode | | | | | | 010 | |
| | SFStreamingNode | | | | | | 010 | |
| | | | | | | | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| description | SFString | 000 | 000 | 000 | | | | |
| loop | SFBool | 001 | 001 | 001 | | | | |
| pitch | SFFloat | 010 | 010 | 010 | | [0, +1] | 0 | 7 |
| startTime | SFTime | 011 | 011 | 011 | | [-1, +1] | | |
| stopTime | SFTime | 100 | 100 | 100 | | [-1, +1] | | |
| url | MFURL | 101 | 101 | 101 | | | | |
| duration_changed | SFTime | | | 110 | | | | |
| isActive | SFBool | | | 111 | | | | |

H.1.6 AudioDelay

| AudioDelay | SFWorldNode SFAudioNode | | | | | | 0000110 011 | | |
|-------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MFAudioNode | | 00 | | | | | | |
| removeChildren | MFAudioNode | | 01 | | | | | | |
| children | MFAudioNode | 00 | 10 | 0 | | | | | |
| delay | SFTime | 01 | 11 | 1 | | [0, +I] | | | |
| numChan | SFInt32 | 10 | | | | [0, 255] | 13,8 | | |
| phaseGroup | MFInt32 | 11 | | | | [0, 255] | 13,8 | | |

H.1.7 AudioFX

| AudioFX | SFWorldNode SFAudioNode | | | | | | 0000111 100 | | |
|-------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MFAudioNode | | 000 | | | | | | |
| removeChildren | MFAudioNode | | 001 | | | | | | |
| children | MFAudioNode | 000 | 010 | 00 | | | | | |
| orch | SFString | 001 | 011 | 01 | | | | | |
| score | SFString | 010 | 100 | 10 | | | | | |
| params | MFFloat | 011 | 101 | 11 | | [-I, +I] | 0 | 7 | |
| numChan | SFInt32 | 100 | | | | [0, 255] | 13,8 | | |
| phaseGroup | MFInt32 | 101 | | | | [0, 255] | 13,8 | | |

H.1.8 AudioMix

| AudioMix | SFWorldNode SFAudioNode | | | | | | 0001000 101 | | |
|-------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MFAudioNode | | 000 | | | | | | |
| removeChildren | MFAudioNode | | 001 | | | | | | |
| children | MFAudioNode | 000 | 010 | 00 | | | | | |
| numInputs | SFInt32 | 001 | 011 | 01 | | [1, 255] | 13,8 | | |
| matrix | MFFloat | 010 | 100 | 10 | | [0, 1] | 0 | 7 | |
| numChan | SFInt32 | 011 | | | | [0, 255] | 13,8 | | |
| phaseGroup | MFInt32 | 100 | | | | [0, 255] | 13,8 | | |

H.1.9 AudioSource

| AudioSource | SFWorldNode SFAudioNode SFStreamingNode | | | | | | 0001001 110 011 | | |
|--------------------|---|---------------|--------------|---------------|---------------|---------------|-----------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MFAudioNode | | 000 | | | | | | |
| removeChildren | MFAudioNode | | 001 | | | | | | |
| children | MFAudioNode | 000 | 010 | 000 | | | | | |
| url | MFURL | 001 | 011 | 001 | | | | | |
| pitch | SFFloat | 010 | 100 | 010 | 0 | [0, +I] | 0 | 7 | |
| speed | SFFloat | 011 | 101 | 011 | 1 | [0, +I] | 0 | 7 | |
| startTime | SFTime | 100 | 110 | 100 | | | | | |
| stopTime | SFTime | 101 | 111 | 101 | | | | | |
| numChan | SFInt32 | 110 | | | | [0, 255] | 13,8 | | |
| phaseGroup | MFInt32 | 111 | | | | [0, 255] | 13,8 | | |

H.1.10 AudioSwitch

| AudioSwitch | SFWorldNode SFAudioNode | | | | | | 0001010 111 | | |
|--------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MFAudioNode | | 00 | | | | | | |
| removeChildren | MFAudioNode | | 01 | | | | | | |
| children | MFAudioNode | 00 | 10 | 0 | | | | | |
| whichChoice | MFInt32 | 01 | 11 | 1 | | [0, 1] | 13,1 | | |
| numChan | SFInt32 | 10 | | | | [0, 255] | 13,8 | | |
| phaseGroup | MFInt32 | 11 | | | | [0, 255] | 13,8 | | |

H.1.11 Background

| Background | SFWorldNode SF3DNode SFBackground3DNode | | | | | | 0001011 000011 1 | | |
|-------------------|---|---------------|--------------|---------------|---------------|-----------------|------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_bind | SFBool | | 0000 | | | | | | |
| groundAngle | MFFloat | 0000 | 0001 | 0000 | 00 | [0, 1.5707963] | 6 | 8 | |
| groundColor | MFCColor | 0001 | 0010 | 0001 | 01 | [0, 1] | 4 | 4 | |
| backUrl | MFURL | 0010 | 0011 | 0010 | | | | | |
| bottomUrl | MFURL | 0011 | 0100 | 0011 | | | | | |
| frontUrl | MFURL | 0100 | 0101 | 0100 | | | | | |
| leftUrl | MFURL | 0101 | 0110 | 0101 | | | | | |
| rightUrl | MFURL | 0110 | 0111 | 0110 | | | | | |
| topUrl | MFURL | 0111 | 1000 | 0111 | | | | | |
| skyAngle | MFFloat | 1000 | 1001 | 1000 | 10 | [0, 3.14159265] | 6 | 8 | |
| skyColor | MFCColor | 1001 | 1010 | 1001 | 11 | [0, 1] | 4 | 4 | |
| isBound | SFBool | | | 1010 | | | | | |

H.1.12 Background2D

| Background2D | SFWorldNode SF2DNode SF3DNode SFBackground2DNode | | | | | | 0001100 00011 000100 1 | | |
|---------------------|---|---------------|--------------|---------------|---------------|---------------|---------------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_bind | SFBool | | 00 | | | | | | |
| backColor | SFColor | 0 | 01 | 00 | | [0, 1] | 4 | 4 | |
| url | MFURL | 1 | 10 | 01 | | | | | |
| isBound | SFBool | | | 10 | | | | | |

H.1.13 Billboard

| Billboard | SFWorldNode SF3DNode | | | | | | 0001101 000101 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MF3DNode | | 00 | | | | | | |
| removeChildren | MF3DNode | | 01 | | | | | | |
| children | MF3DNode | 0 | 10 | 0 | | | | | |
| axisOfRotation | SFVec3f | 1 | 11 | 1 | | | 9 | 9 | |

H.1.14 Bitmap

| Bitmap | SFWorldNode SFGeometryNode | | | | | | 0001110 00001 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| scale | SFVec2f | | | | | [-1, +1] | 12 | 12 | |

H.1.15 Box

| Box | SFWorldNode SFGeometryNode | | | | | | 0001111 00010 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| size | SFVec3f | | | | | [0, +I] | 11 | |

H.1.16 Circle

| Circle | SFWorldNode SFGeometryNode | | | | | | 0010000 00011 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| radius | SFFloat | | | | | [0, +I] | 12 | 7 |

H.1.17 Collision

| Collision | SFWorldNode SF3DNode | | | | | | 0010001 000110 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF3DNode | | 00 | | | | | |
| removeChildren | MF3DNode | | 01 | | | | | |
| children | MF3DNode | 00 | 10 | 00 | | | | |
| collide | SFBool | 01 | 11 | 01 | | | | |
| proxy | SF3DNode | 10 | | | | | | |
| collideTime | SFTime | | | 10 | | | | |

H.1.18 Color

| Color | SFWorldNode SFCColorNode | | | | | | 0010010 1 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| color | MFCColor | | | | | [0, 1] | 4 | 4 |

H.1.19 ColorInterpolator

| ColorInterpolator | SFWorldNode SF3DNode SF2DNode | | | | | | 0010011 000111 00100 | |
|--------------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFCColor | 1 | 10 | 01 | | [0, 1] | 4 | |
| value_changed | SFCColor | | | 10 | | | | |

H.1.20 CompositeTexture2D

| CompositeTexture2D | SFWorldNode SFTextureNode | | | | | | 0010100 001 | |
|---------------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF2DNode | | 000 | | | | | |
| removeChildren | MF2DNode | | 001 | | | | | |
| children | MF2DNode | 000 | 010 | 000 | | | | |
| pixelWidth | SFInt32 | 001 | 011 | 001 | | [0, 65535] | 13,16 | |
| pixelHeight | SFInt32 | 010 | 100 | 010 | | [0, 65535] | 13,16 | |
| background | SFBackground2DNode | 011 | 101 | 011 | | | | |
| viewport | SFViewportNode | 100 | 110 | 100 | | | | |

H.1.21 CompositeTexture3D

| CompositeTexture3D | SFWorldNode SFTextureNode | | | | | 0010101 010 | | |
|---------------------------|--|---------------|--------------|---------------|---------------|----------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF3DNode | | 0000 | | | | | |
| removeChildren | MF3DNode | | 0001 | | | | | |
| children | MF3DNode | 000 | 0010 | 000 | | | | |
| pixelWidth | SFInt32 | 001 | 0011 | 001 | | [0, 65535] | 13,16 | |
| pixelHeight | SFInt32 | 010 | 0100 | 010 | | [0, 65535] | 13,16 | |
| background | SFBackground3DNode | 011 | 0101 | 011 | | | | |
| fog | SFFogNode | 100 | 0110 | 100 | | | | |
| navigationInfo | SFNavigationInfoNode | 101 | 0111 | 101 | | | | |
| viewpoint | SFViewpointNode | 110 | 1000 | 110 | | | | |

H.1.22 Conditional

| Conditional | SFWorldNode SF3DNode SF2DNode | | | | | 0010110 001000 00101 | | |
|--------------------|---|---------------|--------------|---------------|---------------|----------------------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| activate | SFBool | | 00 | | | | | |
| reverseActivate | SFBool | | 01 | | | | | |
| buffer | SFCommandBuffer | | 10 | 0 | | | | |
| isActive | SFBool | | | 1 | | | | |

H.1.23 Cone

| Cone | SFWorldNode SFGeometryNode | | | | | 0010111 00100 | | |
|-------------------|---|---------------|--------------|---------------|---------------|------------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| bottomRadius | SFFloat | 00 | | | | [0, +1] | 11 | |
| height | SFFloat | 01 | | | | [0, +1] | 11 | |
| side | SFBool | 10 | | | | | | |
| bottom | SFBool | 11 | | | | | | |

H.1.24 Coordinate

| Coordinate | SFWorldNode SFCoordinateNode | | | | | 0011000 1 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| point | MFVec3f | | | | | [-1, +1] | 1 | 1 |

H.1.25 Coordinate2D

| Coordinate2D | SFWorldNode SFCoordinate2DNode | | | | | 0011001 1 | | |
|---------------------|---|---------------|--------------|---------------|---------------|---------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| point | MFVec2f | | | | | [-1, +1] | 2 | 2 |

H.1.26 CoordinateInterpolator

| CoordinateInterpolator | SFWorldNode SF3DNode | | | | | 0011010 001001 | | |
|-------------------------------|---|---------------|--------------|---------------|---------------|-------------------|----------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFVec3f | 1 | 10 | 01 | | [-1, +1] | 1 | |
| value_changed | MFVec3f | | | 10 | | | | |

H.1.27 CoordinateInterpolator2D

| | | | | | | | | |
|---------------------------------|---|---------------|--------------|---------------|---------------|----------------------------|----------|----------|
| CoordinateInterpolator2D | SFWorldNode SF2DNode SF3DNode | | | | | 0011011 00110 001010 | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFVec2f | 1 | 10 | 01 | | [-1, +1] | 2 | |
| value_changed | MFVec2f | | | 10 | | | | |

H.1.28 Curve2D

| | | | | | | | | |
|-------------------|---|---------------|--------------|---------------|---------------|------------------|----------|----------|
| Curve2D | SFWorldNode SFGeometryNode | | | | | 0011100 00101 | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| point | SFCoordinate2DNode | 00 | 00 | 00 | | | | |
| fineness | SFFloat | 01 | 01 | 01 | | [0, 1] | 0 | 7 |

H.1.29 Cylinder

| | | | | | | | | |
|-------------------|---|---------------|--------------|---------------|---------------|------------------|----------|----------|
| Cylinder | SFWorldNode SFGeometryNode | | | | | 0011101 00110 | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| bottom | SFBool | 000 | | | | | | |
| height | SFFloat | 001 | | | | [0, +1] | 11 | |
| radius | SFFloat | 010 | | | | [0, +1] | 11 | |
| side | SFBool | 011 | | | | | | |
| top | SFBool | 100 | | | | | | |

H.1.30 CylinderSensor

| | | | | | | | | |
|-----------------------|---|---------------|--------------|---------------|---------------|-------------------|----------|----------|
| CylinderSensor | SFWorldNode SF3DNode | | | | | 0011110 001011 | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| autoOffset | SFBool | 000 | 000 | 0000 | | | | |
| diskAngle | SFFloat | 001 | 001 | 0001 | | [0, 6.2831853] | 6 | |
| enabled | SFBool | 010 | 010 | 0010 | | | | |
| maxAngle | SFFloat | 011 | 011 | 0011 | | [0, 6.2831853] | 6 | |
| minAngle | SFFloat | 100 | 100 | 0100 | | [0, 6.2831853] | 6 | |
| offset | SFFloat | 101 | 101 | 0101 | | [0, 6.2831853] | 6 | |
| isActive | SFBool | | | 0110 | | | | |
| rotation_changed | SFRotation | | | 0111 | | | | |
| trackPoint_changed | SFVec3f | | | 1000 | | | | |

H.1.31 DirectionalLight

| | | | | | | | | |
|-------------------------|---|---------------|--------------|---------------|---------------|-------------------|----------|----------|
| DirectionalLight | SFWorldNode SF3DNode | | | | | 0011111 001100 | | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| ambientIntensity | SFFloat | 000 | 000 | 000 | 00 | [0, 1] | 4 | 8 |
| color | SFColor | 001 | 001 | 001 | 01 | [0, 1] | 4 | 4 |
| direction | SFVec3f | 010 | 010 | 010 | 10 | | 9 | 9 |
| intensity | SFFloat | 011 | 011 | 011 | 11 | [0, 1] | 4 | 8 |
| on | SFBool | 100 | 100 | 100 | | | | |

H.1.32 DiscSensor

| DiscSensor | SFWorldNode SF2DNode SF3DNode | | | | | | 0100000 00111 001101 | |
|--------------------|---|---------------|--------------|---------------|---------------|----------------------------|----------------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| autoOffset | SFBool | 000 | 000 | 000 | | | | |
| enabled | SFBool | 001 | 001 | 001 | | | | |
| maxAngle | SFFloat | 010 | 010 | 010 | | [-6.2831853, 6.2831853] | 6 | |
| minAngle | SFFloat | 011 | 011 | 011 | | [-6.2831853, 6.2831853] | 6 | |
| offset | SFFloat | 100 | 100 | 100 | | [0, 6.2831853] | 6 | |
| isActive | SFBool | | | 101 | | | | |
| rotation_changed | SFFloat | | | 110 | | | | |
| trackPoint_changed | SFVec2f | | | 111 | | | | |

H.1.33 ElevationGrid

| ElevationGrid | SFWorldNode SFGeometryNode | | | | | | 0100001 00111 | |
|----------------------|---|---------------|--------------|---------------|---------------|----------------|------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_height | MFFloat | | 00 | | | | | |
| color | SFColorNode | 0000 | 01 | 00 | | | | |
| normal | SFNormalNode | 0001 | 10 | 01 | | | | |
| texCoord | SFTextureCoordinate Node | 0010 | 11 | 10 | | | | |
| height | MFFloat | 0011 | | | | [-l, +l] | 11 | 7 |
| ccw | SFBool | 0100 | | | | | | |
| colorPerVertex | SFBool | 0101 | | | | | | |
| creaseAngle | SFFloat | 0110 | | | | [0, 6.2831853] | 6 | |
| normalPerVertex | SFBool | 0111 | | | | | | |
| solid | SFBool | 1000 | | | | | | |
| xDimension | SFInt32 | 1001 | | | | [0, +l] | 11 | |
| xSpacing | SFFloat | 1010 | | | | [0, +l] | 11 | |
| zDimension | SFInt32 | 1011 | | | | [0, +l] | 11 | |
| zSpacing | SFFloat | 1100 | | | | [0, +l] | 11 | |

H.1.34 Expression

| Expression | SFWorldNode SFExpressionNode | | | | | | 0100010 1 | |
|-----------------------|---|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| expression_select1 | SFInt32 | 000 | 000 | 000 | | [0, 31] | 13,5 | |
| expression_intensity1 | SFInt32 | 001 | 001 | 001 | | [0, 63] | 13,6 | |
| expression_select2 | SFInt32 | 010 | 010 | 010 | | [0, 31] | 13,5 | |
| expression_intensity2 | SFInt32 | 011 | 011 | 011 | | [0, 63] | 13,6 | |
| init_face | SFBool | 100 | 100 | 100 | | | | |
| expression_def | SFBool | 101 | 101 | 101 | | | | |

H.1.35 Extrusion

| Extrusion | SFWorldNode SFGeometryNode | | | | | | 0100011 01000 | |
|-------------------|---|---------------|--------------|---------------|---------------|----------------|------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_crossSection | MFVec2f | | 00 | | | | | |
| set_orientation | MFRotation | | 01 | | | | | |
| set_scale | MFVec2f | | 10 | | | | | |
| set_spine | MFVec3f | | 11 | | | | | |
| beginCap | SFBool | 0000 | | | | | | |
| ccw | SFBool | 0001 | | | | | | |
| convex | SFBool | 0010 | | | | | | |
| creaseAngle | SFFloat | 0011 | | | | [0, 6.2831853] | 6 | |
| crossSection | MFVec2f | 0100 | | | | [-1, +1] | 2 | |
| endCap | SFBool | 0101 | | | | | | |
| orientation | MFRotation | 0110 | | | | [-1, +1] | 10 | |
| scale | MFVec2f | 0111 | | | | [0, +1] | 7 | |
| solid | SFBool | 1000 | | | | | | |
| spine | MFVec3f | 1001 | | | | [-1, +1] | 1 | |

H.1.36 Face

| Face | SFWorldNode SF3DNode SF2DNode | | | | | | 0100100 001110 01000 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| fap | SFFAPNode | 000 | 000 | 000 | | | | |
| fdp | SFFDPNode | 001 | 001 | 001 | | | | |
| fit | SFFITNode | 010 | 010 | 010 | | | | |
| ttsSource | SFAudioNode | 011 | 011 | 011 | | | | |
| renderedFace | MF3DNode | 100 | 100 | 100 | | | | |

H.1.37 FaceDefMesh

| FaceDefMesh | SFWorldNode SFFaceDefMeshNode | | | | | | 0100101 1 | |
|--------------------|--|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| faceSceneGraphNode | SF3DNode | 00 | | | | | | |
| intervalBorders | MFIInt32 | 01 | | | | | 0 | |
| coordIndex | MFIInt32 | 10 | | | | | 0 | |
| displacements | MFVec3f | 11 | | | | | 0 | |

H.1.38 FaceDefTables

| FaceDefTables | SFWorldNode SFFaceDefTablesNode | | | | | | 0100110 1 | |
|----------------------|--|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| fapID | SFIInt32 | 00 | | | | [1, 68] | 13,7 | |
| highLevelSelect | SFIInt32 | 01 | | | | [1, 64] | 13,6 | |
| faceDefMesh | MFFaceDefMeshNode | 10 | 0 | 0 | | | | |
| faceDefTransform | MFFaceDefTransformNode | 11 | 1 | 1 | | | | |

H.1.39 FaceDefTransform

| FaceDefTransform | SFWorldNode SFFaceDefTransformNode | | | | | | 0100111 1 | |
|-------------------------|---|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| faceSceneGraphNode | SF3DNode | 000 | | | | | | |

| | | | | | | | |
|----------------|------------|-----|--|--|----------|----|--|
| fieldId | SFInt32 | 001 | | | | | |
| rotationDef | SFRotation | 010 | | | [-1, +1] | 10 | |
| scaleDef | SFVec3f | 011 | | | | 7 | |
| translationDef | SFVec3f | 100 | | | | 1 | |

H.1.40 FAP

| FAP | SFWorldNode SFFAPNode | | | | | | 0101000 1 | |
|-------------------|--|---------|---------|---------|--------|----------|--------------|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| viseme | SFVisemeNode | 0000000 | 0000000 | 0000000 | | | | |
| expression | SFExpressionNode | 0000001 | 0000001 | 0000001 | | | | |
| open_jaw | SFInt32 | 0000010 | 0000010 | 0000010 | | [0, +1] | 0 | |
| lower_t_midlip | SFInt32 | 0000011 | 0000011 | 0000011 | | [-1, +1] | 0 | |
| raise_b_midlip | SFInt32 | 0000100 | 0000100 | 0000100 | | [-1, +1] | 0 | |
| stretch_l_corner | SFInt32 | 0000101 | 0000101 | 0000101 | | [-1, +1] | 0 | |
| stretch_r_corner | SFInt32 | 0000110 | 0000110 | 0000110 | | [-1, +1] | 0 | |
| lower_t_lip_lm | SFInt32 | 0000111 | 0000111 | 0000111 | | [-1, +1] | 0 | |
| lower_t_lip_rm | SFInt32 | 0001000 | 0001000 | 0001000 | | [-1, +1] | 0 | |
| lower_b_lip_lm | SFInt32 | 0001001 | 0001001 | 0001001 | | [-1, +1] | 0 | |
| lower_b_lip_rm | SFInt32 | 0001010 | 0001010 | 0001010 | | [-1, +1] | 0 | |
| raise_l_cornerlip | SFInt32 | 0001011 | 0001011 | 0001011 | | [-1, +1] | 0 | |
| raise_r_cornerlip | SFInt32 | 0001100 | 0001100 | 0001100 | | [-1, +1] | 0 | |
| thrust_jaw | SFInt32 | 0001101 | 0001101 | 0001101 | | [0, +1] | 0 | |
| shift_jaw | SFInt32 | 0001110 | 0001110 | 0001110 | | [-1, +1] | 0 | |
| push_b_lip | SFInt32 | 0001111 | 0001111 | 0001111 | | [-1, +1] | 0 | |
| push_t_lip | SFInt32 | 0010000 | 0010000 | 0010000 | | [-1, +1] | 0 | |
| depress_chin | SFInt32 | 0010001 | 0010001 | 0010001 | | [-1, +1] | 0 | |
| close_t_l_eyelid | SFInt32 | 0010010 | 0010010 | 0010010 | | [-1, +1] | 0 | |
| close_t_r_eyelid | SFInt32 | 0010011 | 0010011 | 0010011 | | [-1, +1] | 0 | |
| close_b_l_eyelid | SFInt32 | 0010100 | 0010100 | 0010100 | | [-1, +1] | 0 | |
| close_b_r_eyelid | SFInt32 | 0010101 | 0010101 | 0010101 | | [-1, +1] | 0 | |
| yaw_l_eyeball | SFInt32 | 0010110 | 0010110 | 0010110 | | [-1, +1] | 0 | |
| yaw_r_eyeball | SFInt32 | 0010111 | 0010111 | 0010111 | | [-1, +1] | 0 | |
| pitch_l_eyeball | SFInt32 | 0011000 | 0011000 | 0011000 | | [-1, +1] | 0 | |
| pitch_r_eyeball | SFInt32 | 0011001 | 0011001 | 0011001 | | [-1, +1] | 0 | |
| thrust_l_eyeball | SFInt32 | 0011010 | 0011010 | 0011010 | | [-1, +1] | 0 | |
| thrust_r_eyeball | SFInt32 | 0011011 | 0011011 | 0011011 | | [-1, +1] | 0 | |
| dilate_l_pupil | SFInt32 | 0011100 | 0011100 | 0011100 | | [-1, +1] | 0 | |
| dilate_r_pupil | SFInt32 | 0011101 | 0011101 | 0011101 | | [-1, +1] | 0 | |
| raise_l_i_eyebrow | SFInt32 | 0011110 | 0011110 | 0011110 | | [-1, +1] | 0 | |
| raise_r_i_eyebrow | SFInt32 | 0011111 | 0011111 | 0011111 | | [-1, +1] | 0 | |
| raise_l_m_eyebrow | SFInt32 | 0100000 | 0100000 | 0100000 | | [-1, +1] | 0 | |
| raise_r_m_eyebrow | SFInt32 | 0100001 | 0100001 | 0100001 | | [-1, +1] | 0 | |
| raise_l_o_eyebrow | SFInt32 | 0100010 | 0100010 | 0100010 | | [-1, +1] | 0 | |
| raise_r_o_eyebrow | SFInt32 | 0100011 | 0100011 | 0100011 | | [-1, +1] | 0 | |
| squeeze_l_eyebrow | SFInt32 | 0100100 | 0100100 | 0100100 | | [-1, +1] | 0 | |
| squeeze_r_eyebrow | SFInt32 | 0100101 | 0100101 | 0100101 | | [-1, +1] | 0 | |
| puff_l_cheek | SFInt32 | 0100110 | 0100110 | 0100110 | | [-1, +1] | 0 | |
| puff_r_cheek | SFInt32 | 0100111 | 0100111 | 0100111 | | [-1, +1] | 0 | |
| lift_l_cheek | SFInt32 | 0101000 | 0101000 | 0101000 | | [0, +1] | 0 | |
| lift_r_cheek | SFInt32 | 0101001 | 0101001 | 0101001 | | [0, +1] | 0 | |
| shift_tongue_tip | SFInt32 | 0101010 | 0101010 | 0101010 | | [-1, +1] | 0 | |
| raise_tongue_tip | SFInt32 | 0101011 | 0101011 | 0101011 | | [-1, +1] | 0 | |
| thrust_tongue_tip | SFInt32 | 0101100 | 0101100 | 0101100 | | [-1, +1] | 0 | |
| raise_tongue | SFInt32 | 0101101 | 0101101 | 0101101 | | [-1, +1] | 0 | |
| tongue_roll | SFInt32 | 0101110 | 0101110 | 0101110 | | [0, +1] | 0 | |
| head_pitch | SFInt32 | 0101111 | 0101111 | 0101111 | | [-1, +1] | 0 | |
| head_yaw | SFInt32 | 0110000 | 0110000 | 0110000 | | [-1, +1] | 0 | |
| head_roll | SFInt32 | 0110001 | 0110001 | 0110001 | | [-1, +1] | 0 | |
| lower_t_midlip_o | SFInt32 | 0110010 | 0110010 | 0110010 | | [-1, +1] | 0 | |

| | | | | | | | | |
|---------------------|---------|---------|---------|---------|--|----------|---|--|
| raise_b_midlip_o | SFInt32 | 0110011 | 0110011 | 0110011 | | [-I, +I] | 0 | |
| stretch_l_cornerlip | SFInt32 | 0110100 | 0110100 | 0110100 | | [-I, +I] | 0 | |
| stretch_r_cornerlip | SFInt32 | 0110101 | 0110101 | 0110101 | | [-I, +I] | 0 | |
| lower_t_lip_lm_o | SFInt32 | 0110110 | 0110110 | 0110110 | | [-I, +I] | 0 | |
| lower_t_lip_rm_o | SFInt32 | 0110111 | 0110111 | 0110111 | | [-I, +I] | 0 | |
| raise_b_lip_lm_o | SFInt32 | 0111000 | 0111000 | 0111000 | | [-I, +I] | 0 | |
| raise_b_lip_rm_o | SFInt32 | 0111001 | 0111001 | 0111001 | | [-I, +I] | 0 | |
| raise_l_cornerlip_o | SFInt32 | 0111010 | 0111010 | 0111010 | | [-I, +I] | 0 | |
| raise_r_cornerlip_o | SFInt32 | 0111011 | 0111011 | 0111011 | | [-I, +I] | 0 | |
| stretch_l_nose | SFInt32 | 0111100 | 0111100 | 0111100 | | [-I, +I] | 0 | |
| stretch_r_nose | SFInt32 | 0111101 | 0111101 | 0111101 | | [-I, +I] | 0 | |
| raise_nose | SFInt32 | 0111110 | 0111110 | 0111110 | | [-I, +I] | 0 | |
| bend_nose | SFInt32 | 0111111 | 0111111 | 0111111 | | [-I, +I] | 0 | |
| raise_l_ear | SFInt32 | 1000000 | 1000000 | 1000000 | | [-I, +I] | 0 | |
| raise_r_ear | SFInt32 | 1000001 | 1000001 | 1000001 | | [-I, +I] | 0 | |
| pull_l_ear | SFInt32 | 1000010 | 1000010 | 1000010 | | [-I, +I] | 0 | |
| pull_r_ear | SFInt32 | 1000011 | 1000011 | 1000011 | | [-I, +I] | 0 | |

H.1.41 FDP

| FDP | SFWorldNode SFFDPNode | | | | | | 0101001 1 | | |
|--------------------|--|--------|-------|--------|--------|--------|--------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| featurePointsCoord | SFCoordinateNode | 000 | 00 | 00 | | | | | |
| textureCoord | SFTextureCoordinate Node | 001 | 01 | 01 | | | | | |
| faceDefTables | MFFaceDefTablesNode | 010 | 10 | 10 | | | | | |
| faceSceneGraph | MF3DNode | 011 | 11 | 11 | | | | | |
| useOrthoTexture | SFBool | 100 | | | | | | | |

H.1.42 FIT

| FIT | SFWorldNode SFFITNode | | | | | | 0101010 1 | | |
|------------------|--|--------|-------|--------|--------|-----------|--------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| FAPs | MFInt32 | 0000 | 0000 | 0000 | | [-1, 68] | 13,7 | | |
| Graph | MFInt32 | 0001 | 0001 | 0001 | | [0, 68] | 13,7 | | |
| numeratorExp | MFInt32 | 0010 | 0010 | 0010 | | [0, 15] | 13,4 | | |
| denominatorExp | MFInt32 | 0011 | 0011 | 0011 | | [0, 15] | 13,4 | | |
| numeratorImpulse | MFInt32 | 0100 | 0100 | 0100 | | [0, 1023] | 13,10 | | |
| numeratorTerms | MFInt32 | 0101 | 0101 | 0101 | | [0, 10] | 13,4 | | |
| denominatorTerms | MFInt32 | 0110 | 0110 | 0110 | | [0, 10] | 13,4 | | |
| numeratorCoefs | MFFloat | 0111 | 0111 | 0111 | | [-I, +I] | | | |
| denominatorCoefs | MFFloat | 1000 | 1000 | 1000 | | [-I, +I] | | | |

H.1.43 Fog

| Fog | SFWorldNode SF3DNode SFFogNode | | | | | | 0101011 001111 1 | | |
|-----------------|--|--------|-------|--------|--------|---------|------------------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| color | SFColor | 00 | 00 | 00 | 0 | [0, 1] | 4 | 4 | |
| fogType | SFString | 01 | 01 | 01 | | | | | |
| visibilityRange | SFFloat | 10 | 10 | 10 | 1 | [0, +I] | 11 | 7 | |
| set_bind | SFBool | | 11 | | | | | | |
| isBound | SFBool | | | 11 | | | | | |

H.1.44 FontStyle

| FontStyle | SFWorldNode SFFontStyleNode | | | | | | 0101100 1 | | |
|-------------------|--|---------------|--------------|---------------|---------------|---------------|--------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| family | MFString | 0000 | | | | | | | |
| horizontal | SFBool | 0001 | | | | | | | |
| justify | MFString | 0010 | | | | | | | |
| language | SFString | 0011 | | | | | | | |
| leftToRight | SFBool | 0100 | | | | | | | |
| size | SFFloat | 0101 | | | | [0, +] | 11 | | |
| spacing | SFFloat | 0110 | | | | [0, +] | 11 | | |
| style | SFString | 0111 | | | | | | | |
| topToBottom | SFBool | 1000 | | | | | | | |

H.1.45 Form

| Form | SFWorldNode SF2DNode SF3DNode | | | | | | 0101101 01001 010000 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MF2DNode | | 000 | | | | | | |
| removeChildren | MF2DNode | | 001 | | | | | | |
| children | MF2DNode | 000 | 010 | 000 | | | | | |
| size | SFVec2f | 001 | 011 | 001 | | [0, +] | 12 | 12 | |
| groups | MFInt32 | 010 | 100 | 010 | | [-1, 1022] | 13,10 | | |
| constraints | MFString | 011 | 101 | 011 | | | | | |
| groupsIndex | MFInt32 | 100 | 110 | 100 | | [-1, 1022] | 13,10 | | |

H.1.46 Group

| Group | SFWorldNode SFTopNode SF3DNode SF2DNode | | | | | | 0101110 001 010001 01010 | | |
|-------------------|--|---------------|--------------|---------------|---------------|---------------|-----------------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| addChildren | MF3DNode | | 00 | | | | | | |
| removeChildren | MF3DNode | | 01 | | | | | | |
| children | MF3DNode | | 10 | | | | | | |

H.1.47 ImageTexture

| ImageTexture | SFWorldNode SFTextureNode | | | | | | 0101111 011 | | |
|---------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| url | MFURL | 00 | | | | | | | |
| repeatS | SFBool | 01 | | | | | | | |
| repeatT | SFBool | 10 | | | | | | | |

H.1.48 IndexedFaceSet

| IndexedFaceSet | SFWorldNode SFGeometryNode | | | | | | 0110000 01001 | | |
|-----------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_colorIndex | MFInt32 | | 000 | | | | | | |
| set_coordIndex | MFInt32 | | 001 | | | | | | |
| set_normalIndex | MFInt32 | | 010 | | | | | | |
| set_texCoordIndex | MFInt32 | | 011 | | | | | | |
| color | SFCColorNode | 0000 | 100 | 00 | | | | | |
| coord | SFCoordinateNode | 0001 | 101 | 01 | | | | | |
| normal | SFNormalNode | 0010 | 110 | 10 | | | | | |
| texCoord | SFTextureCoordinate Node | 0011 | 111 | 11 | | | | | |

| | | | | | | | | |
|-----------------|---------|------|--|--|--|----------------|----|--|
| ccw | SFBool | 0100 | | | | | | |
| colorIndex | MFInt32 | 0101 | | | | [-1, +I] | 14 | |
| colorPerVertex | SFBool | 0110 | | | | | | |
| convex | SFBool | 0111 | | | | | | |
| coordIndex | MFInt32 | 1000 | | | | [-1, +I] | 14 | |
| creaseAngle | SFFloat | 1001 | | | | [0, 6.2831853] | 6 | |
| normalIndex | MFInt32 | 1010 | | | | [-1, +I] | 14 | |
| normalPerVertex | SFBool | 1011 | | | | | | |
| solid | SFBool | 1100 | | | | | | |
| texCoordIndex | MFInt32 | 1101 | | | | [-1, +I] | 14 | |

H.1.49 IndexedFaceSet2D

| IndexedFaceSet2D | SFWorldNode SFGeometryNode | | | | | | 0110001 01010 | | |
|-------------------|---|--------|-------|--------|--------|---------|------------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_colorIndex | MFInt32 | | 000 | | | | | | |
| set_coordIndex | MFInt32 | | 001 | | | | | | |
| set_texCoordIndex | MFInt32 | | 010 | | | | | | |
| color | SFCColorNode | 000 | 011 | 00 | | | | | |
| coord | SFCoordinate2DNode | 001 | 100 | 01 | | | | | |
| texCoord | SFTextureCoordinate Node | 010 | 101 | 10 | | | | | |
| colorIndex | MFInt32 | 011 | | | | [0, +I] | 14 | | |
| colorPerVertex | SFBool | 100 | | | | | | | |
| convex | SFBool | 101 | | | | | | | |
| coordIndex | MFInt32 | 110 | | | | [0, +I] | 14 | | |
| texCoordIndex | MFInt32 | 111 | | | | [0, +I] | 14 | | |

H.1.50 IndexedLineSet

| IndexedLineSet | SFWorldNode SFGeometryNode | | | | | | 0110010 01011 | | |
|----------------|---|--------|-------|--------|--------|----------|------------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_colorIndex | MFInt32 | | 00 | | | | | | |
| set_coordIndex | MFInt32 | | 01 | | | | | | |
| color | SFCColorNode | 000 | 10 | 0 | | | | | |
| coord | SFCoordinateNode | 001 | 11 | 1 | | | | | |
| colorIndex | MFInt32 | 010 | | | | [-1, +I] | 14 | | |
| colorPerVertex | SFBool | 011 | | | | | | | |
| coordIndex | MFInt32 | 100 | | | | [-1, +I] | 14 | | |

H.1.51 IndexedLineSet2D

| IndexedLineSet2D | SFWorldNode SFGeometryNode | | | | | | 0110011 01100 | | |
|------------------|---|--------|-------|--------|--------|---------|------------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_colorIndex | MFInt32 | | 00 | | | | | | |
| set_coordIndex | MFInt32 | | 01 | | | | | | |
| color | SFCColorNode | 000 | 10 | 0 | | | | | |
| coord | SFCoordinate2DNode | 001 | 11 | 1 | | | | | |
| colorIndex | MFInt32 | 010 | | | | [0, +I] | 14 | | |
| colorPerVertex | SFBool | 011 | | | | | | | |
| coordIndex | MFInt32 | 100 | | | | [0, +I] | 14 | | |

H.1.52 Inline

| | | |
|-------------------|--|-----------------------------------|
| Inline | SFWorldNode SF3DNode SFStreamingNode SF2DNode | 0110100 010010 100 01011 |
| Field name | Field type | DEF id |
| url | MFURL | |

H.1.53 LOD

| | | |
|-------------------|---|----------------------------|
| LOD | SFWorldNode SF3DNode SF2DNode | 0110101 010011 01100 |
| Field name | Field type | DEF id |
| level | MF3DNode | 00 |
| center | SFVec3f | 01 |
| range | MFFloat | 10 |

H.1.54 Layer2D

| | | |
|-------------------|--|-----------------------------------|
| Layer2D | SFWorldNode SFTopNode SF2DNode SF3DNode | 0110110 010 01101 010100 |
| Field name | Field type | DEF id |
| addChild | MF2DNode | 000 |
| removeChild | MF2DNode | 001 |
| children | MF2DNode | 00 |
| size | SFVec2f | 01 |
| background | SFBackground2DNode | 10 |
| viewport | SFViewportNode | 11 |

H.1.55 Layer3D

| | | |
|-------------------|--|-----------------------------------|
| Layer3D | SFWorldNode SFTopNode SF2DNode SF3DNode | 0110111 011 01110 010101 |
| Field name | Field type | DEF id |
| addChild | MF3DNode | 000 |
| removeChild | MF3DNode | 001 |
| children | MF3DNode | 000 |
| size | SFVec2f | 001 |
| background | SFBackground3DNode | 010 |
| fog | SFFogNode | 011 |
| navigationInfo | SFNavigationInfoNode | 100 |
| viewpoint | SFViewpointNode | 101 |

H.1.56 Layout

| | | |
|-------------------|---|----------------------------|
| Layout | SFWorldNode SF2DNode SF3DNode | 0111000 01111 010100 |
| Field name | Field type | DEF id |
| addChild | MF2DNode | 0000 |
| removeChild | MF2DNode | 0001 |
| children | MF2DNode | 0000 |
| wrap | SFBool | 0001 |
| size | SFVec2f | 0010 |
| horizontal | SFBool | 0011 |
| justify | MFString | 0100 |
| leftToRight | SFBool | 0101 |

| | | | | | | | | |
|----------------|---------|------|------|------|----|----------|---|---|
| topToBottom | SFBool | 0110 | 1000 | 0110 | | | | |
| spacing | SFFloat | 0111 | 1001 | 0111 | 01 | [0, +I] | 0 | 7 |
| smoothScroll | SFBool | 1000 | 1010 | 1000 | | | | |
| loop | SFBool | 1001 | 1011 | 1001 | | | | |
| scrollVertical | SFBool | 1010 | 1100 | 1010 | | | | |
| scrollRate | SFFloat | 1011 | 1101 | 1011 | 10 | [-I, +I] | 0 | 7 |

H.1.57 LineProperties

| LineProperties | SFWorldNode SFLinePropertiesNode | | | | | | 0111001 1 | | |
|----------------|---|--------|-------|--------|--------|---------|--------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| lineColor | SFCOLOR | 00 | 00 | 00 | 0 | [0, 1] | 4 | 4 | |
| lineStyle | SFI32 | 01 | 01 | 01 | | [0, 5] | 13,3 | | |
| width | SFFloat | 10 | 10 | 10 | 1 | [0, +I] | 12 | 7 | |

H.1.58 ListeningPoint

| ListeningPoint | SFWorldNode SF3DNode | | | | | | 0111010 010111 | | |
|----------------|---|--------|-------|--------|--------|----------|-------------------|----|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_bind | SFBool | | 00 | | | | | | |
| jump | SFBool | 00 | 01 | 000 | | | | | |
| orientation | SFRotation | 01 | 10 | 001 | 0 | | 10 | 10 | |
| position | SFVec3f | 10 | 11 | 010 | 1 | [-I, +I] | 1 | 1 | |
| description | SFString | 11 | | | | | | | |
| bindTime | SFTIME | | | 011 | | | | | |
| isBound | SFBool | | | 100 | | | | | |

H.1.59 Material

| Material | SFWorldNode SFMaterialNode | | | | | | 0111011 01 | | |
|------------------|---|--------|-------|--------|--------|--------|---------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| ambientIntensity | SFFloat | 000 | 000 | 000 | 000 | [0, 1] | 4 | 8 | |
| diffuseColor | SFCOLOR | 001 | 001 | 001 | 001 | [0, 1] | 4 | 4 | |
| emissiveColor | SFCOLOR | 010 | 010 | 010 | 010 | [0, 1] | 4 | 4 | |
| shininess | SFFloat | 011 | 011 | 011 | 011 | [0, 1] | 4 | 8 | |
| specularColor | SFCOLOR | 100 | 100 | 100 | 100 | [0, 1] | 4 | 4 | |
| transparency | SFFloat | 101 | 101 | 101 | 101 | [0, 1] | 4 | 8 | |

H.1.60 Material2D

| Material2D | SFWorldNode SFMaterialNode | | | | | | 0111100 10 | | |
|---------------|---|--------|-------|--------|--------|--------|---------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| emissiveColor | SFCOLOR | 00 | 00 | 00 | 0 | [0, 1] | 4 | 4 | |
| filled | SFBool | 01 | 01 | 01 | | | | | |
| lineProps | SFLinePropertiesNode | 10 | 10 | 10 | | | | | |
| transparency | SFFloat | 11 | 11 | 11 | 1 | [0, 1] | 4 | 8 | |

H.1.61 MovieTexture

| MovieTexture | SFWorldNode SFTextureNode SFSStreamingNode | | | | | | 0111101 100 101 | | |
|--------------|--|--------|-------|--------|--------|----------|-----------------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| loop | SFBool | 000 | 000 | 000 | | | | | |
| speed | SFFloat | 001 | 001 | 001 | | [-I, +I] | 0 | 7 | |

| | | | | | | | | |
|------------------|--------|-----|-----|-----|--|---------|--|--|
| startTime | SFTime | 010 | 010 | 010 | | [-, +I] | | |
| stopTime | SFTime | 011 | 011 | 011 | | [-, +I] | | |
| url | MFURL | 100 | 100 | 100 | | | | |
| repeatS | SFBool | 101 | | | | | | |
| repeatT | SFBool | 110 | | | | | | |
| duration_changed | SFTime | | | 101 | | | | |
| isActive | SFBool | | | 110 | | | | |

H.1.62 NavigationInfo

| NavigationInfo | SFWorldNode SF3DNode SFNavigationInfoNode | | | | | 0111110 011000 1 | | |
|-----------------|---|--------|-------|--------|--------|------------------------|----|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_bind | SFBool | | 000 | | | | | |
| avatarSize | MFFloat | 000 | 001 | 000 | | [0, +I] | 11 | |
| headlight | SFBool | 001 | 010 | 001 | | | | |
| speed | SFFloat | 010 | 011 | 010 | | [0, +I] | 0 | |
| type | MFString | 011 | 100 | 011 | | | | |
| visibilityLimit | SFFloat | 100 | 101 | 100 | | [0, +I] | 11 | 7 |
| isBound | SFBool | | | 101 | | | | |

H.1.63 Normal

| Normal | SFWorldNode SFNormalNode | | | | | 0111111 1 | | |
|------------|-----------------------------|--------|-------|--------|--------|--------------|---|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| vector | MFVec3f | | | | | | 9 | 9 |

H.1.64 NormallInterpolator

| NormallInterpolator | SFWorldNode SF3DNode | | | | | 1000000 011001 | | |
|---------------------|-------------------------|--------|-------|--------|--------|-------------------|---|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFVec3f | 1 | 10 | 01 | | [-, +I] | 9 | |
| value_changed | MFVec3f | | | 10 | | | | |

H.1.65 OrderedGroup

| OrderedGroup | SFWorldNode SF3DNode SF2DNode SFTopNode | | | | | 1000001 011010 10000 100 | | |
|----------------|--|--------|-------|--------|--------|-----------------------------------|---|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF3DNode | | 00 | | | | | |
| removeChildren | MF3DNode | | 01 | | | | | |
| children | MF3DNode | 0 | 10 | 0 | | | | |
| order | MFFloat | 1 | 11 | 1 | | [0, +I] | 3 | |

H.1.66 OrientationInterpolator

| OrientationInterpolator | SFWorldNode SF3DNode | | | | | 1000010 011011 | | |
|-------------------------|-------------------------|--------|-------|--------|--------|-------------------|----|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFRotation | 1 | 10 | 01 | | [-, +I] | 10 | |
| value_changed | SFRotation | | | 10 | | | | |

H.1.67 PixelTexture

| PixelTexture | SFWorldNode SFTextureNode | | | | | | 1000011 101 | | |
|---------------------|--|---------------|--------------|---------------|---------------|---------------|----------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| image | SFImage | 00 | | | | | 0 | | |
| repeatS | SFBool | 01 | | | | | | | |
| repeatT | SFBool | 10 | | | | | | | |

H.1.68 PlaneSensor

| PlaneSensor | SFWorldNode SF3DNode | | | | | | 1000100 011100 | | |
|---------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| autoOffset | SFBool | 000 | 000 | 000 | | | | | |
| enabled | SFBool | 001 | 001 | 001 | | | | | |
| maxPosition | SFVec2f | 010 | 010 | 010 | | [-1, +1] | 2 | | |
| minPosition | SFVec2f | 011 | 011 | 011 | | [-1, +1] | 2 | | |
| offset | SFVec3f | 100 | 100 | 100 | | [-1, +1] | 1 | | |
| isActive | SFBool | | | 101 | | | | | |
| trackPoint_changed | SFVec3f | | | 110 | | | | | |
| translation_changed | SFVec3f | | | 111 | | | | | |

H.1.69 PlaneSensor2D

| PlaneSensor2D | SFWorldNode SF2DNode SF3DNode | | | | | | 1000101 10001 011101 | | |
|----------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| autoOffset | SFBool | 000 | 000 | 000 | | | | | |
| enabled | SFBool | 001 | 001 | 001 | | | | | |
| maxPosition | SFVec2f | 010 | 010 | 010 | | [-1, +1] | 2 | | |
| minPosition | SFVec2f | 011 | 011 | 011 | | [-1, +1] | 2 | | |
| offset | SFVec2f | 100 | 100 | 100 | | [-1, +1] | 12 | | |
| isActive | SFBool | | | 101 | | | | | |
| trackPoint_changed | SFVec2f | | | 110 | | | | | |
| translation_changed | SFVec2f | | | 111 | | | | | |

H.1.70 PointLight

| PointLight | SFWorldNode SF3DNode | | | | | | 1000110 011110 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| ambientIntensity | SFFloat | 000 | 000 | 000 | 000 | [0, 1] | 4 | 8 | |
| attenuation | SFVec3f | 001 | 001 | 001 | 001 | [0, +1] | 11 | 1 | |
| color | SFCOLOR | 010 | 010 | 010 | 010 | [0, 1] | 4 | 4 | |
| intensity | SFFloat | 011 | 011 | 011 | 011 | [0, 1] | 4 | 8 | |
| location | SFVec3f | 100 | 100 | 100 | 100 | [-1, +1] | 1 | 1 | |
| on | SFBool | 101 | 101 | 101 | | | | | |
| radius | SFFloat | 110 | 110 | 110 | 101 | [0, +1] | 11 | 7 | |

H.1.71 PointSet

| PointSet | SFWorldNode SFGeometryNode | | | | | | 1000111 01101 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| color | SFCOLORNODE | 0 | 0 | 0 | | | | | |
| coord | SFCOORDINATENODE | 1 | 1 | 1 | | | | | |

H.1.72 PointSet2D

| PointSet2D | SFWorldNode SFGeometryNode | | | | | | 1001000 01110 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| color | SFColorNode | 0 | 0 | 0 | | | | | |
| coord | SFCoordinate2DNode | 1 | 1 | 1 | | | | | |

H.1.73 PositionInterpolator

| PositionInterpolator | SFWorldNode SF3DNode | | | | | | 1001001 011111 | | |
|-----------------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_fraction | SFFloat | | 00 | | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | | |
| keyValue | MFVec3f | 1 | 10 | 01 | | [-I, +I] | 1 | | |
| value_changed | SFVec3f | | | 10 | | | | | |

H.1.74 PositionInterpolator2D

| PositionInterpolator2D | SFWorldNode SF2DNode SF3DNode | | | | | | 1001010 10010 100000 | | |
|-------------------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_fraction | SFFloat | | 00 | | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | | |
| keyValue | MFVec2f | 1 | 10 | 01 | | [-I, +I] | 2 | | |
| value_changed | SFVec2f | | | 10 | | | | | |

H.1.75 ProximitySensor2D

| ProximitySensor2D | SFWorldNode SF2DNode SF3DNode | | | | | | 1001011 10011 100001 | | |
|--------------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| center | SFVec2f | 00 | 00 | 000 | | [-I, +I] | 2 | | |
| size | SFVec2f | 01 | 01 | 001 | | [0, +I] | 12 | | |
| enabled | SFBool | 10 | 10 | 010 | | | | | |
| isActive | SFBool | | | 011 | | | | | |
| position_changed | SFVec2f | | | 100 | | | | | |
| orientation_changed | SFFloat | | | 101 | | | | | |
| enterTime | SFTime | | | 110 | | | | | |
| exitTime | SFTime | | | 111 | | | | | |

H.1.76 ProximitySensor

| ProximitySensor | SFWorldNode SF3DNode | | | | | | 1001100 100010 | | |
|------------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| center | SFVec3f | 00 | 00 | 000 | | [-I, +I] | 1 | | |
| size | SFVec3f | 01 | 01 | 001 | | [0, +I] | 11 | | |
| enabled | SFBool | 10 | 10 | 010 | | | | | |
| isActive | SFBool | | | 011 | | | | | |
| position_changed | SFVec3f | | | 100 | | | | | |
| orientation_changed | SFRotation | | | 101 | | | | | |
| enterTime | SFTime | | | 110 | | | | | |
| exitTime | SFTime | | | 111 | | | | | |

H.1.77 QuantizationParameter

| QuantizationParameter | SFWorldNode SF2DNode SF3DNode | | | | | | 1001101 10100 100011 | | |
|------------------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| isLocal | SFBool | 000000 | | | | | | | |
| position3DQuant | SFBool | 000001 | | | | | | | |

| | | | | | | | |
|--------------------------|---------|--------|--|--|----------------|------|--|
| position3DMin | SFVec3f | 000010 | | | [-, +I] | 0 | |
| position3DMax | SFVec3f | 000011 | | | [-, +I] | 0 | |
| position3DNbBits | SFInt32 | 000100 | | | [0, 31] | 13,5 | |
| position2DQuant | SFBool | 000101 | | | | | |
| position2DMin | SFVec2f | 000110 | | | [-, +I] | 0 | |
| position2DMax | SFVec2f | 000111 | | | [-, +I] | 0 | |
| position2DNbBits | SFInt32 | 001000 | | | [0, 31] | 13,5 | |
| drawOrderQuant | SFBool | 001001 | | | | | |
| drawOrderMin | SFFloat | 001010 | | | [-, +I] | 0 | |
| drawOrderMax | SFFloat | 001011 | | | [-, +I] | 0 | |
| drawOrderNbBits | SFInt32 | 001100 | | | [0, 31] | 13,5 | |
| colorQuant | SFBool | 001101 | | | | | |
| colorMin | SFFloat | 001110 | | | [0, 1] | 0 | |
| colorMax | SFFloat | 001111 | | | [0, 1] | 0 | |
| colorNbBits | SFInt32 | 010000 | | | [0, 31] | 13,5 | |
| textureCoordinateQua nt | SFBool | 010001 | | | | | |
| textureCoordinateMin | SFFloat | 010010 | | | [0, 1] | 0 | |
| textureCoordinateMax | SFFloat | 010011 | | | [0, 1] | 0 | |
| textureCoordinateNbB its | SFInt32 | 010100 | | | [0, 31] | 13,5 | |
| angleQuant | SFBool | 010101 | | | | | |
| angleMin | SFFloat | 010110 | | | [0, 6.2831853] | 0 | |
| angleMax | SFFloat | 010111 | | | [0, 6.2831853] | 0 | |
| angleNbBits | SFInt32 | 011000 | | | [0, 31] | 13,5 | |
| scaleQuant | SFBool | 011001 | | | | | |
| scaleMin | SFFloat | 011010 | | | [0, +I] | 0 | |
| scaleMax | SFFloat | 011011 | | | [0, +I] | 0 | |
| scaleNbBits | SFInt32 | 011100 | | | [0, 31] | 13,5 | |
| keyQuant | SFBool | 011101 | | | | | |
| keyMin | SFFloat | 011110 | | | [-, +I] | 0 | |
| keyMax | SFFloat | 011111 | | | [-, +I] | 0 | |
| keyNbBits | SFInt32 | 100000 | | | [0, 31] | 13,5 | |
| normalQuant | SFBool | 100001 | | | | | |
| normalNbBits | SFInt32 | 100010 | | | [0, 31] | 13,5 | |
| sizeQuant | SFBool | 100011 | | | | | |
| sizeMin | SFFloat | 100100 | | | [-, +I] | 0 | |
| sizeMax | SFFloat | 100101 | | | [-, +I] | 0 | |
| sizeNbBits | SFInt32 | 100110 | | | [0, 31] | 13,5 | |
| useEfficientCoding | SFBool | 100111 | | | | | |

H.1.78 Rectangle

| | | | | | | | | |
|-------------------|-------------------------------|---------------|--------------|---------------|------------------|---------------|----------|----------|
| Rectangle | SFWorldNode SFGeometryNode | | | | 1001110 01111 | | | |
| <i>Field name</i> | <i>Field type</i> | <i>DEF id</i> | <i>IN id</i> | <i>OUT id</i> | <i>DYN id</i> | <i>[m, M]</i> | <i>Q</i> | <i>A</i> |
| size | SFVec2f | | | | | [0, +I] | 12 | 2 |

H.1.79 ScalarInterpolator

| | | | | | | | | |
|--------------------|-------------------------------------|---------------|--------------|---------------|----------------------------|---------------|----------|----------|
| ScalarInterpolator | SFWorldNode SF3DNode SF2DNode | | | | 1001111 100100 10101 | | | |
| <i>Field name</i> | <i>Field type</i> | <i>DEF id</i> | <i>IN id</i> | <i>OUT id</i> | <i>DYN id</i> | <i>[m, M]</i> | <i>Q</i> | <i>A</i> |
| set_fraction | SFFloat | | 00 | | | | | |
| key | MFFloat | 0 | 01 | 00 | | [0, 1] | 8 | |
| keyValue | MFFloat | 1 | 10 | 01 | | [-, +I] | 0 | |
| value_changed | SFFloat | | | 10 | | | | |

H.1.80 Script

| Script | SFWorldNode SF3DNode SF2DNode | | | | | | 1010000 100101 10110 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| url | MFScript | 00 | | | | | | | |
| directOutput | SFBool | 01 | | | | | | | |
| mustEvaluate | SFBool | 10 | | | | | | | |

H.1.81 Shape

| Shape | SFWorldNode SF3DNode SF2DNode | | | | | | 1010001 100110 10111 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| appearance | SFAppearanceNode | 0 | 0 | 0 | | | | | |
| geometry | SFGeometryNode | 1 | 1 | 1 | | | | | |

H.1.82 Sound

| Sound | SFWorldNode SF3DNode | | | | | | 1010010 100111 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| direction | SFVec3f | 0000 | 0000 | 0000 | | [-I, +I] | 9 | | |
| intensity | SFFloat | 0001 | 0001 | 0001 | 000 | [0, 1] | 4 | 7 | |
| location | SFVec3f | 0010 | 0010 | 0010 | 001 | [-I, +I] | 1 | 1 | |
| maxBack | SFFloat | 0011 | 0011 | 0011 | 010 | [0, +I] | 11 | 7 | |
| maxFront | SFFloat | 0100 | 0100 | 0100 | 011 | [0, +I] | 11 | 7 | |
| minBack | SFFloat | 0101 | 0101 | 0101 | 100 | [0, +I] | 11 | 7 | |
| minFront | SFFloat | 0110 | 0110 | 0110 | 101 | [0, +I] | 11 | 7 | |
| priority | SFFloat | 0111 | 0111 | 0111 | | [0, 1] | 4 | | |
| source | SFAudioNode | 1000 | 1000 | 1000 | | | | | |
| spatialize | SFBool | 1001 | | | | | | | |

H.1.83 Sound2D

| Sound2D | SFWorldNode SF2DNode SF3DNode | | | | | | 1010011 11000 101000 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| intensity | SFFloat | 00 | 00 | 00 | 0 | [0, 1] | 4 | 7 | |
| location | SFVec2f | 01 | 01 | 01 | 1 | [-I, +I] | 2 | 2 | |
| source | SFAudioNode | 10 | 10 | 10 | | | | | |
| spatialize | SFBool | 11 | | | | | | | |

H.1.84 Sphere

| Sphere | SFWorldNode SFGeometryNode | | | | | | 1010100 10000 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| radius | SFFloat | | | | | [0, +I] | 11 | | |

H.1.85 SphereSensor

| SphereSensor | SFWorldNode SF3DNode | | | | | | 1010101 101001 | | |
|---------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| autoOffset | SFBool | 00 | 00 | 000 | | | | | |
| enabled | SFBool | 01 | 01 | 001 | | | | | |
| offset | SFRotation | 10 | 10 | 010 | | [-I, +I] | 10 | | |
| isActive | SFBool | | | 011 | | | | | |
| rotation_changed | SFRotation | | | 100 | | | | | |
| trackPoint_changed | SFVec3f | | | 101 | | | | | |

H.1.86 SpotLight

| SpotLight | SFWorldNode SF3DNode | | | | | | 1010110 101010 | | |
|-------------------|---|---------------|--------------|---------------|---------------|----------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| ambientIntensity | SFFloat | 0000 | 0000 | 0000 | 0000 | [0, 1] | 4 | 8 | |
| attenuation | SFVec3f | 0001 | 0001 | 0001 | 0001 | [0, +I] | 11 | 1 | |
| beamWidth | SFFloat | 0010 | 0010 | 0010 | 0010 | [0, 1.5707963] | 6 | 8 | |
| color | SFCOLOR | 0011 | 0011 | 0011 | 0011 | [0, 1] | 4 | 4 | |
| cutOffAngle | SFFloat | 0100 | 0100 | 0100 | 0100 | [0, 1.5707963] | 6 | 8 | |
| direction | SFVec3f | 0101 | 0101 | 0101 | 0101 | [-I, +I] | 9 | 9 | |
| intensity | SFFloat | 0110 | 0110 | 0110 | 0110 | [0, 1] | 4 | 8 | |
| location | SFVec3f | 0111 | 0111 | 0111 | 0111 | [-I, +I] | 1 | 1 | |
| on | SFBool | 1000 | 1000 | 1000 | | | | | |
| radius | SFFloat | 1001 | 1001 | 1001 | 1000 | [0, +I] | 11 | 7 | |

H.1.87 Switch

| Switch | SFWorldNode SF3DNode SF2DNode | | | | | | 1010111 101011 11001 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| choice | MF3DNode | 0 | 0 | 0 | | | | | |
| whichChoice | SFInt32 | 1 | 1 | 1 | | [-1, 1022] | 13,10 | | |

H.1.88 TermCap

| TermCap | SFWorldNode SF3DNode SF2DNode | | | | | | 1011000 11010 101100 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| evaluate | SFTIME | | 0 | | | | | | |
| capability | SFInt32 | | 1 | 0 | | [0, 127] | 13,7 | | |
| value | SFInt32 | | | 1 | | [0, 7] | 13,3 | | |

H.1.89 Text

| Text | SFWorldNode SFGeometryNode | | | | | | 1011001 10001 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| string | MFString | 00 | 00 | 00 | | | | | |
| length | MFFloat | 01 | 01 | 01 | 0 | [0, +I] | 11 | 7 | |
| fontStyle | SFFontStyleNode | 10 | 10 | 10 | | | | | |
| maxExtent | SFFloat | 11 | 11 | 11 | 1 | [0, +I] | 11 | 7 | |

H.1.90 TextureCoordinate

| TextureCoordinate | SFWorldNode SFTextureCoordinateNode | | | | | | 1011010 1 | | |
|--------------------------|--|---------------|--------------|---------------|---------------|---------------|--------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| point | MFVec2f | | | | | [-I, +I] | 5 | 2 | |

H.1.91 TextureTransform

| TextureTransform | SFWorldNode SFTextureTransformNode | | | | | | 1011011 1 | | |
|-------------------------|---|---------------|--------------|---------------|---------------|----------------|--------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| center | SFVec2f | 00 | 00 | 00 | 00 | [-I, +I] | 2 | 2 | |
| rotation | SFFloat | 01 | 01 | 01 | 01 | [0, 6.2831853] | 6 | 6 | |
| scale | SFVec2f | 10 | 10 | 10 | 10 | [-I, +I] | 7 | 12 | |
| translation | SFVec2f | 11 | 11 | 11 | 11 | [-I, +I] | 2 | 2 | |

H.1.92 TimeSensor

| | | | | | | | | |
|-------------------|-------------------------------------|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|
| TimeSensor | SFWorldNode SF3DNode SF2DNode | | | | | | 1011100 101101 11011 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| cycleInterval | SFTime | 000 | 000 | 0000 | | [0, +I] | | |
| enabled | SFBool | 001 | 001 | 0001 | | | | |
| loop | SFBool | 010 | 010 | 0010 | | | | |
| startTime | SFTime | 011 | 011 | 0011 | | [-I, +I] | | |
| stopTime | SFTime | 100 | 100 | 0100 | | [-I, +I] | | |
| cycleTime | SFTime | | | 0101 | | | | |
| fraction_changed | SFFloat | | | 0110 | | | | |
| isActive | SFBool | | | 0111 | | | | |
| time | SFTime | | | 1000 | | | | |

H.1.93 TouchSensor

| | | | | | | | | |
|---------------------|-------------------------------------|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|
| TouchSensor | SFWorldNode SF2DNode SF3DNode | | | | | | 1011101 11100 101110 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| enabled | SFBool | | | 000 | | | | |
| hitNormal_changed | SFVec3f | | | 001 | | | | |
| hitPoint_changed | SFVec3f | | | 010 | | | | |
| hitTexCoord_changed | SFVec2f | | | 011 | | | | |
| isActive | SFBool | | | 100 | | | | |
| isOver | SFBool | | | 101 | | | | |
| touchTime | SFTime | | | 110 | | | | |

H.1.94 Transform

| | | | | | | | | |
|-------------------|-------------------------|---------------|--------------|---------------|---------------|---------------|-------------------|----------|
| Transform | SFWorldNode SF3DNode | | | | | | 1011110 101111 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF3DNode | | 000 | | | | | |
| removeChildren | MF3DNode | | 001 | | | | | |
| center | SFVec3f | 000 | 010 | 000 | 000 | [-I, +I] | 1 | 1 |
| children | MF3DNode | 001 | 011 | 001 | | | | |
| rotation | SFRotation | 010 | 100 | 010 | 001 | | 10 | 10 |
| scale | SFVec3f | 011 | 101 | 011 | 010 | [0, +I] | 7 | 11 |
| scaleOrientation | SFRotation | 100 | 110 | 100 | 011 | | 10 | 10 |
| translation | SFVec3f | 101 | 111 | 101 | 100 | [-I, +I] | 1 | 1 |

H.1.95 Transform2D

| | | | | | | | | |
|--------------------|-------------------------------------|---------------|--------------|---------------|---------------|----------------|----------------------------|----------|
| Transform2D | SFWorldNode SF2DNode SF3DNode | | | | | | 1011111 11101 110000 | |
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| addChildren | MF2DNode | | 000 | | | | | |
| removeChildren | MF2DNode | | 001 | | | | | |
| children | MF2DNode | 000 | 010 | 000 | | | | |
| center | SFVec2f | 001 | 011 | 001 | 000 | [-I, +I] | 2 | 2 |
| rotationAngle | SFFloat | 010 | 100 | 010 | 001 | [0, 6.2831853] | 6 | 6 |
| scale | SFVec2f | 011 | 101 | 011 | 010 | [0, +I] | 7 | 12 |
| scaleOrientation | SFFloat | 100 | 110 | 100 | 011 | [0, 6.2831853] | 6 | 6 |
| translation | SFVec2f | 101 | 111 | 101 | 100 | [-I, +I] | 2 | 2 |

H.1.96 Valuator

| Valuator | SFWorldNode SF3DNode SF2DNode | | | | | | 1100000 110001 11110 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| inSFBool | SFBool | | 00000 | | | | | | |
| inSFCOLOR | SFCOLOR | | 00001 | | | | | | |
| inMFColor | MFColor | | 00010 | | | | | | |
| inSFFloat | SFFloat | | 00011 | | | | | | |
| inMFFloat | MFFloat | | 00100 | | | | | | |
| inSFInt32 | SFInt32 | | 00101 | | | | | | |
| inMFInt32 | MFInt32 | | 00110 | | | | | | |
| inSFRotation | SFRotation | | 00111 | | | | | | |
| inMFRotation | MFRotation | | 01000 | | | | | | |
| inSFString | SFString | | 01001 | | | | | | |
| inMFString | MFString | | 01010 | | | | | | |
| inSFTIME | SFTIME | | 01011 | | | | | | |
| inSFVec2f | SFVec2f | | 01100 | | | | | | |
| inMFVec2f | MFVec2f | | 01101 | | | | | | |
| inSFVec3f | SFVec3f | | 01110 | | | | | | |
| inMFVec3f | MFVec3f | | 01111 | | | | | | |
| outSFBool | SFBool | | | 00000 | | | | | |
| outSFCOLOR | SFCOLOR | | | 00001 | | | | | |
| outMFColor | MFColor | | | 00010 | | | | | |
| outSFFloat | SFFloat | | | 00011 | | | | | |
| outMFFloat | MFFloat | | | 00100 | | | | | |
| outSFInt32 | SFInt32 | | | 00101 | | | | | |
| outMFInt32 | MFInt32 | | | 00110 | | | | | |
| outSFRotation | SFRotation | | | 00111 | | | | | |
| outMFRotation | MFRotation | | | 01000 | | | | | |
| outSFString | SFString | | | 01001 | | | | | |
| outMFString | MFString | | | 01010 | | | | | |
| outSFTIME | SFTIME | | | 01011 | | | | | |
| outSFVec2f | SFVec2f | | | 01100 | | | | | |
| outMFVec2f | MFVec2f | | | 01101 | | | | | |
| outSFVec3f | SFVec3f | | | 01110 | | | | | |
| outMFVec3f | MFVec3f | | | 01111 | | | | | |
| Factor1 | SFFloat | 0000 | 10000 | 10000 | | [-I, +I] | 0 | | |
| Factor2 | SFFloat | 0001 | 10001 | 10001 | | [-I, +I] | 0 | | |
| Factor3 | SFFloat | 0010 | 10010 | 10010 | | [-I, +I] | 0 | | |
| Factor4 | SFFloat | 0011 | 10011 | 10011 | | [-I, +I] | 0 | | |
| Offset1 | SFFloat | 0100 | 10100 | 10100 | | [-I, +I] | 0 | | |
| Offset2 | SFFloat | 0101 | 10101 | 10101 | | [-I, +I] | 0 | | |
| Offset3 | SFFloat | 0110 | 10110 | 10110 | | [-I, +I] | 0 | | |
| Offset4 | SFFloat | 0111 | 10111 | 10111 | | [-I, +I] | 0 | | |
| Sum | SFBool | 1000 | 11000 | 11000 | | | | | |

H.1.97 Viewpoint

| Viewpoint | SFWorldNode SF3DNode SFViewpointNode | | | | | | 1100001 110010 1 | | |
|-------------------|--|---------------|--------------|---------------|---------------|----------------|------------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| set_bind | SFBool | | 000 | | | | | | |
| fieldOfView | SFFloat | 000 | 001 | 000 | 00 | [0, 3.1415927] | 6 | 8 | |
| jump | SFBool | 001 | 010 | 001 | | | | | |
| orientation | SFRotation | 010 | 011 | 010 | 01 | | 10 | 10 | |
| position | SFVec3f | 011 | 100 | 011 | 10 | [-I, +I] | 1 | 1 | |
| description | SFString | 100 | | | | | | | |
| bindTime | SFTIME | | | 100 | | | | | |
| isBound | SFBool | | | 101 | | | | | |

H.1.98 VisibilitySensor

| VisibilitySensor | SFWorldNode SF3DNode | | | | | | 1100010 110011 | |
|-------------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| center | SFVec3f | 00 | 00 | 000 | 0 | | 1 | 1 |
| enabled | SFBool | 01 | 01 | 001 | | | | |
| size | SFVec3f | 10 | 10 | 010 | 1 | | 11 | 11 |
| enterTime | SFTime | | | 011 | | | | |
| exitTime | SFTime | | | 100 | | | | |
| isActive | SFBool | | | 101 | | | | |

H.1.99 Viseme

| Viseme | SFWorldNode SFVisemeNode | | | | | | 1100011 1 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|--------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| viseme_select1 | SFInt32 | 00 | 00 | 00 | | [0, 31] | 13,5 | |
| viseme_select2 | SFInt32 | 01 | 01 | 01 | | [0, 31] | 13,5 | |
| viseme_blend | SFInt32 | 10 | 10 | 10 | | [0, 63] | 13,6 | |
| viseme_def | SFBool | 11 | 11 | 11 | | | | |

H.1.100 WorldInfo

| WorldInfo | SFWorldNode SF2DNode SF3DNode | | | | | | 1100100 11111 110100 | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|----------------------------|----------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| info | MFString | 0 | | | | | | |
| title | SFString | 1 | | | | | | |

H.2 Node Definition Type Tables

Legend:

| Node Definition Type | Number of nodes | | | |
|-----------------------------|------------------------|-----|----|-----|
| Node name | nodeType | DEF | IN | OUT |

H.2.1 SF2DNode

| SF2DNode | 31 Nodes | | | | |
|--|-----------------|------------|-----------|------------|------------|
| reserved | 00000 | | | | |
| Anchor | 00001 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AnimationStream | 00010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Background2D | 00011 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ColorInterpolator | 00100 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Conditional | 00101 | 0 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| CoordinateInterpolator2D | 00110 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| DiscSensor | 00111 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Face | 01000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Form | 01001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Group | 01010 | 0 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| Inline | 01011 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| LOD | 01100 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Layer2D | 01101 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| Layer3D | 01110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Layout | 01111 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |
| OrderedGroup | 10000 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| PlaneSensor2D | 10001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PositionInterpolator2D | 10010 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ProximitySensor2D | 10011 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| QuantizationParameter | 10100 | 6 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

| | | | | | |
|------------------------------------|-------|------------|-----------|------------|------------|
| ScalarInterpolator | 10101 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Script | 10110 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Shape | 10111 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Sound2D | 11000 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| Switch | 11001 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| TermCap | 11010 | 0 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| TimeSensor | 11011 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| TouchSensor | 11100 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |
| Transform2D | 11101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Valuator | 11110 | 4 DEF bits | 5 IN bits | 5 OUT bits | 0 DYN bits |
| WorldInfo | 11111 | 1 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.2 SF3DNode

| SF3DNode | 52 Nodes | | | | |
|--|----------|------------|-----------|------------|------------|
| reserved | 000000 | | | | |
| Anchor | 000001 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AnimationStream | 000010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Background | 000011 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |
| Background2D | 000100 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Billboard | 000101 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| Collision | 000110 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ColorInterpolator | 000111 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Conditional | 001000 | 0 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| CoordinateInterpolator | 001001 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| CoordinateInterpolator2D | 001010 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| CylinderSensor | 001011 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| DirectionalLight | 001100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| DiscSensor | 001101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Face | 001110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Fog | 001111 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| Form | 010000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Group | 010001 | 0 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| Inline | 010010 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| LOD | 010011 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Layer2D | 010100 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| Layer3D | 010101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Layout | 010110 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |
| ListeningPoint | 010111 | 2 DEF bits | 2 IN bits | 3 OUT bits | 1 DYN bits |
| NavigationInfo | 011000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| NormalInterpolator | 011001 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| OrderedGroup | 011010 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| OrientationInterpolator | 011011 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| PlaneSensor | 011100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PlaneSensor2D | 011101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PointLight | 011110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| PositionInterpolator | 011111 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| PositionInterpolator2D | 100000 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ProximitySensor2D | 100001 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| ProximitySensor | 100010 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| QuantizationParameter | 100011 | 6 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| ScalarInterpolator | 100100 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Script | 100101 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Shape | 100110 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Sound | 100111 | 4 DEF bits | 4 IN bits | 4 OUT bits | 3 DYN bits |
| Sound2D | 101000 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| SphereSensor | 101001 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| SpotLight | 101010 | 4 DEF bits | 4 IN bits | 4 OUT bits | 4 DYN bits |
| Switch | 101011 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| TermCap | 101100 | 0 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| TimeSensor | 101101 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| TouchSensor | 101110 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |

| | | | | | |
|----------------------------------|--------|------------|-----------|------------|------------|
| Transform | 101111 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Transform2D | 110000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Valuator | 110001 | 4 DEF bits | 5 IN bits | 5 OUT bits | 0 DYN bits |
| Viewpoint | 110010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| VisibilitySensor | 110011 | 2 DEF bits | 2 IN bits | 3 OUT bits | 1 DYN bits |
| WorldInfo | 110100 | 1 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.3 SFAppearanceNode

| SFAppearanceNode | 1 Node | | | | |
|----------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Appearance | 1 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.2.4 SFAudioNode

| SFAudioNode | 7 Nodes | | | | |
|------------------------------|---------|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| AudioBuffer | 001 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| AudioClip | 010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| AudioDelay | 011 | 2 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| AudioFX | 100 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AudioMix | 101 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AudioSource | 110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 1 DYN bits |
| AudioSwitch | 111 | 2 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |

H.2.5 SFBackground2DNode

| SFBackground2DNode | 1 Node | | | | |
|------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Background2D | 1 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.2.6 SFBackground3DNode

| SFBackground3DNode | 1 Node | | | | |
|----------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Background | 1 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |

H.2.7 SFColorNode

| SFColorNode | 1 Node | | | | |
|-----------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Color | 1 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.8 SFCoordinate2DNode

| SFCordinate2DNode | 1 Node | | | | |
|------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Coordinate2D | 1 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.9 SFCoordinateNode

| SFCoordinateNode | 1 Node | | | | |
|----------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Coordinate | 1 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.10 SFExpressionNode

| SFExpressionNode | 1 Node | | | | |
|----------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Expression | 1 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |

H.2.11 SFFAPNode

| SFFAPNode | 1 Node | | | | |
|---------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FAP | 1 | 7 DEF bits | 7 IN bits | 7 OUT bits | 0 DYN bits |

H.2.12 SFFDPNode

| SFFDPNode | 1 Node | | | | |
|---------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FDP | 1 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.2.13 SFFITNode

| SFFITNode | 1 Node | | | | |
|---------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FIT | 1 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |

H.2.14 SFFaceDefMeshNode

| SFFaceDefMeshNode | 1 Node | | | | |
|-----------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FaceDefMesh | 1 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.15 SFFaceDefTablesNode

| SFFaceDefTablesNode | 1 Node | | | | |
|-------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FaceDefTables | 1 | 2 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |

H.2.16 SFFaceDefTransformNode

| SFFaceDefTransformNode | 1 Node | | | | |
|----------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FaceDefTransform | 1 | 3 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.17 SFFogNode

| SFFogNode | 1 Node | | | | |
|---------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Fog | 1 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |

H.2.18 SFFontStyleNode

| SFFontStyleNode | 1 Node | | | | |
|---------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| FontStyle | 1 | 4 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.19 SFGeometryNode

| SFGeometryNode | 17 Nodes | | | | |
|-------------------------------|----------|------------|-----------|------------|------------|
| reserved | 00000 | | | | |
| Bitmap | 00001 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Box | 00010 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Circle | 00011 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Cone | 00100 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Curve2D | 00101 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Cylinder | 00110 | 3 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| ElevationGrid | 00111 | 4 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

| | | | | | |
|----------------------------------|-------|------------|-----------|------------|------------|
| Extrusion | 01000 | 4 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| IndexedFaceSet | 01001 | 4 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| IndexedFaceSet2D | 01010 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| IndexedLineSet | 01011 | 3 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| IndexedLineSet2D | 01100 | 3 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| PointSet | 01101 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| PointSet2D | 01110 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Rectangle | 01111 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Sphere | 10000 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Text | 10001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |

H.2.20 SFLinePropertiesNode

| SFLinePropertiesNode | 1 Node | | | | |
|--------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| LineProperties | 1 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |

H.2.21 SFMaterialNode

| SFMaterialNode | 2 Nodes | | | | |
|----------------------------|---------|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| Material | 01 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Material2D | 10 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |

H.2.22 SFNavigationInfoNode

| SFNavigationInfoNode | 1 Node | | | | |
|--------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| NavigationInfo | 1 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |

H.2.23 SFNormalNode

| SFNormalNode | 1 Node | | | | |
|------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Normal | 1 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.24 SFStreamingNode

| SFStreamingNode | 5 Nodes | | | | |
|---------------------------------|---------|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| AnimationStream | 001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| AudioClip | 010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| AudioSource | 011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 1 DYN bits |
| Inline | 100 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| MovieTexture | 101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |

H.2.25 SFTextureCoordinateNode

| SFTextureCoordinateNode | 1 Node | | | | |
|-----------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| TextureCoordinate | 1 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.26 SFTextureNode

| SFTextureNode | 5 Nodes | | | | |
|------------------------------------|---------|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| CompositeTexture2D | 001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| CompositeTexture3D | 010 | 3 DEF bits | 4 IN bits | 3 OUT bits | 0 DYN bits |
| ImageTexture | 011 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| MovieTexture | 100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PixelTexture | 101 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.2.27 SFTextureTransformNode

| SFTextureTransformNode | 1 Node | | | | |
|----------------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| TextureTransform | 1 | 2 DEF bits | 2 IN bits | 2 OUT bits | 2 DYN bits |

H.2.28 SFTopNode

| SFTopNode | 4 Nodes | | | | |
|------------------------------|---------|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| Group | 001 | 0 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| Layer2D | 010 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| Layer3D | 011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| OrderedGroup | 100 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |

H.2.29 SFViewpointNode

| SFViewpointNode | 1 Node | | | | |
|---------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Viewpoint | 1 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |

H.2.30 SFViewportNode

| SFViewportNode | 0 Nodes | | | | |
|----------------|---------|--|--|--|--|
| Reserved | 0 | | | | |

H.2.31 SFVisemeNode

| SFVisemeNode | 1 Node | | | | |
|------------------------|--------|------------|-----------|------------|------------|
| reserved | 0 | | | | |
| Viseme | 1 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |

H.2.32 SFWorldNode

| SFWorldNode | 100 Nodes | | | | |
|-------------------------------------|-----------|------------|-----------|------------|------------|
| reserved | 0000000 | | | | |
| Anchor | 0000001 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AnimationStream | 0000010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Appearance | 0000011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| AudioBuffer | 0000100 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| AudioClip | 0000101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| AudioDelay | 0000110 | 2 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| AudioFX | 0000111 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AudioMix | 0001000 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| AudioSource | 0001001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 1 DYN bits |
| AudioSwitch | 0001010 | 2 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| Background | 0001011 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |
| Background2D | 0001100 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Billboard | 0001101 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| Bitmap | 0001110 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Box | 0001111 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Circle | 0010000 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Collision | 0010001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Color | 0010010 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| ColorInterpolator | 0010011 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| CompositeTexture2D | 0010100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| CompositeTexture3D | 0010101 | 3 DEF bits | 4 IN bits | 3 OUT bits | 0 DYN bits |
| Conditional | 0010110 | 0 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| Cone | 0010111 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Coordinate | 0011000 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

| | | | | | |
|--|---------|------------|-----------|------------|------------|
| Coordinate2D | 0011001 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| CoordinateInterpolator | 0011010 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| CoordinateInterpolator2D | 0011011 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Curve2D | 0011100 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Cylinder | 0011101 | 3 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| CylinderSensor | 0011110 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| DirectionalLight | 0011111 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| DiscSensor | 0100000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| ElevationGrid | 0100001 | 4 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Expression | 0100010 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Extrusion | 0100011 | 4 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| Face | 0100100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| FaceDefMesh | 0100101 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| FaceDefTables | 0100110 | 2 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| FaceDefTransform | 0100111 | 3 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| FAP | 0101000 | 7 DEF bits | 7 IN bits | 7 OUT bits | 0 DYN bits |
| FDP | 0101001 | 3 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| FIT | 0101010 | 4 DEF bits | 4 IN bits | 4 OUT bits | 0 DYN bits |
| Fog | 0101011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| FontStyle | 0101100 | 4 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Form | 0101101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Group | 0101110 | 0 DEF bits | 2 IN bits | 0 OUT bits | 0 DYN bits |
| ImageTexture | 0101111 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| IndexedFaceSet | 0110000 | 4 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| IndexedFaceSet2D | 0110001 | 3 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| IndexedLineSet | 0110010 | 3 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| IndexedLineSet2D | 0110011 | 3 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| Inline | 0110100 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| LOD | 0110101 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Layer2D | 0110110 | 2 DEF bits | 3 IN bits | 2 OUT bits | 0 DYN bits |
| Layer3D | 0110111 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Layout | 0111000 | 4 DEF bits | 4 IN bits | 4 OUT bits | 2 DYN bits |
| LineProperties | 0111001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| ListeningPoint | 0111010 | 2 DEF bits | 2 IN bits | 3 OUT bits | 1 DYN bits |
| Material | 0111011 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Material2D | 0111100 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| MovieTexture | 0111101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| NavigationInfo | 0111110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Normal | 0111111 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| NormalInterpolator | 1000000 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| OrderedGroup | 1000001 | 1 DEF bits | 2 IN bits | 1 OUT bits | 0 DYN bits |
| OrientationInterpolator | 1000010 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| PixelTexture | 1000011 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| PlaneSensor | 1000100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PlaneSensor2D | 1000101 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| PointLight | 1000110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| PointSet | 1000111 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| PointSet2D | 1001000 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| PositionInterpolator | 1001001 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| PositionInterpolator2D | 1001010 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| ProximitySensor2D | 1001011 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| ProximitySensor | 1001100 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| QuantizationParameter | 1001101 | 6 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Rectangle | 1001110 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| ScalarInterpolator | 1001111 | 1 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| Script | 1010000 | 2 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| Shape | 1010001 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Sound | 1010010 | 4 DEF bits | 4 IN bits | 4 OUT bits | 3 DYN bits |
| Sound2D | 1010011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| Sphere | 1010100 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| SphereSensor | 1010101 | 2 DEF bits | 2 IN bits | 3 OUT bits | 0 DYN bits |
| SpotLight | 1010110 | 4 DEF bits | 4 IN bits | 4 OUT bits | 4 DYN bits |

| | | | | | |
|-----------------------------------|---------|------------|-----------|------------|------------|
| Switch | 1010111 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| TermCap | 1011000 | 0 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Text | 1011001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 1 DYN bits |
| TextureCoordinate | 1011010 | 0 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |
| TextureTransform | 1011011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 2 DYN bits |
| TimeSensor | 1011100 | 3 DEF bits | 3 IN bits | 4 OUT bits | 0 DYN bits |
| TouchSensor | 1011101 | 0 DEF bits | 0 IN bits | 3 OUT bits | 0 DYN bits |
| Transform | 1011110 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Transform2D | 1011111 | 3 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| Valuator | 1100000 | 4 DEF bits | 5 IN bits | 5 OUT bits | 0 DYN bits |
| Viewpoint | 1100001 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| VisibilitySensor | 1100010 | 2 DEF bits | 2 IN bits | 3 OUT bits | 1 DYN bits |
| Viseme | 1100011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| WorldInfo | 1100100 | 1 DEF bits | 0 IN bits | 0 OUT bits | 0 DYN bits |

H.3 Node Tables for Extended Nodes

| Node Name | Node Data Type list | | | | | nodeType/NDT | | |
|------------|---------------------|--------|-------|--------|--------|--------------|--------------|------------------|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [min, max] | Quantizer id | Animation method |

H.3.1 AcousticMaterial

| AcousticMaterial | SFMaterialNode SFWorldNode | | | | | 10 0010 | | |
|----------------------------------|---|--------|-------|--------|--------|------------|---|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| ambientIntensity | SFFloat | 0000 | 000 | 000 | 000 | [0, 1] | 4 | 8 |
| diffuseColor | SFColor | 0001 | 001 | 001 | 001 | [0, 1] | 4 | 8 |
| emissiveColor | SFColor | 0010 | 010 | 010 | 010 | [0, 1] | 4 | 8 |
| shininess | SFFloat | 0011 | 011 | 011 | 011 | [0, 1] | 4 | 8 |
| specularColor | SFColor | 0100 | 100 | 100 | 100 | [0, 1] | 4 | 8 |
| transparency | SFFloat | 0101 | 101 | 101 | 101 | [0, 1] | 4 | 8 |
| reffunc | MFFloat | 0110 | | | | [-1, +1] | 0 | |
| transfunc | MFFloat | 0111 | | | | [-1, +1] | 0 | |
| refFrequency | MFFloat | 1000 | | | | [0, +1] | 0 | |
| transFrequency | MFFloat | 1001 | | | | [0, +1] | 0 | |

H.3.2 AcousticScene

| AcousticScene | SFWorldNode SF3DNode | | | | | 0011 010 | | |
|-------------------------------|---|--------|-------|--------|--------|-------------|----|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| center | SFVec3f | 000 | | | | [-1, +1] | 1 | |
| Size | SFVec3f | 001 | | | | [-1, +1] | 11 | |
| reverbTime | MFTime | 010 | | | | [0, +1] | 0 | |
| reverbFreq | MFFloat | 011 | | | | [0, +1] | 0 | |
| reverbLevel | SFFloat | 100 | 0 | 0 | 0 | [0, +1] | 0 | 7 |
| reverbDelay | SFTime | 101 | 1 | 1 | 1 | [0, +1] | 0 | 0 |

H.3.3 ApplicationWindow

| ApplicationWindow | SFWorldNode SF2DNode | | | | | 0100 10 | | |
|-----------------------------------|---|--------|---------|--------|--------|------------|----------|----|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| isActive | SFBool | 000 | 000 | 000 | | | | |
| startTime | SFTime | 001 | 001 | 001 | | [-1, +1] | 0 | |
| stopTime | SFTime | 010 | 010 | 010 | | [-1, +1] | 0 | |
| description | SFString | 011 | 011 | 011 | | | | |
| parameter | MFString | 100 | 100 | 100 | | | | |
| url | MFURL | 101 | 101 | 101 | | | | |
| size | | | SFVec2f | 110 | 110 | 110 | [-1, +1] | 12 |

H.3.4 BAP

| BAP | SFWorldNode SFBAPNode | | | | | | 0101 10 | |
|----------------------------|--------------------------|-----------|------------|------------|--------|----------|------------|---|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A |
| sacroiliac_tilt | SFInt32 | 000000000 | 0000000000 | 0000000000 | | [-I, +I] | 0 | |
| sacroiliac_torsion | SFInt32 | 000000001 | 0000000001 | 0000000001 | | [-I, +I] | 0 | |
| sacroiliac_roll | SFInt32 | 000000010 | 0000000010 | 0000000010 | | [-I, +I] | 0 | |
| l_hip_flexion | SFInt32 | 000000011 | 0000000011 | 0000000011 | | [-I, +I] | 0 | |
| r_hip_flexion | SFInt32 | 000000100 | 0000000100 | 0000000100 | | [-I, +I] | 0 | |
| l_hip_abduct | SFInt32 | 000000101 | 0000000101 | 0000000101 | | [-I, +I] | 0 | |
| r_hip_abduct | SFInt32 | 000000110 | 0000000110 | 0000000110 | | [-I, +I] | 0 | |
| l_hip_twisting | SFInt32 | 000000111 | 0000000111 | 0000000111 | | [-I, +I] | 0 | |
| r_hip_twisting | SFInt32 | 000001000 | 0000001000 | 0000001000 | | [-I, +I] | 0 | |
| l_knee_flexion | SFInt32 | 000001001 | 0000001001 | 0000001001 | | [-I, +I] | 0 | |
| r_knee_flexion | SFInt32 | 000001010 | 0000001010 | 0000001010 | | [-I, +I] | 0 | |
| l_knee_twisting | SFInt32 | 000001011 | 0000001011 | 0000001011 | | [-I, +I] | 0 | |
| r_knee_twisting | SFInt32 | 000001100 | 0000001100 | 0000001100 | | [-I, +I] | 0 | |
| l_ankle_flexion | SFInt32 | 000001101 | 0000001101 | 0000001101 | | [-I, +I] | 0 | |
| r_ankle_flexion | SFInt32 | 000001110 | 0000001110 | 0000001110 | | [-I, +I] | 0 | |
| l_ankle_twisting | SFInt32 | 000001111 | 0000001111 | 0000001111 | | [-I, +I] | 0 | |
| r_ankle_twisting | SFInt32 | 000010000 | 0000010000 | 0000010000 | | [-I, +I] | 0 | |
| l_subtalar_flexion | SFInt32 | 000010001 | 0000010001 | 0000010001 | | [-I, +I] | 0 | |
| r_subtalar_flexion | SFInt32 | 000010010 | 0000010010 | 0000010010 | | [-I, +I] | 0 | |
| l_midtarsal_flexion | SFInt32 | 000010011 | 0000010011 | 0000010011 | | [-I, +I] | 0 | |
| r_midtarsal_flexion | SFInt32 | 000010100 | 0000010100 | 0000010100 | | [-I, +I] | 0 | |
| l_metatarsal_flexion | SFInt32 | 000010101 | 0000010101 | 0000010101 | | [-I, +I] | 0 | |
| r_metatarsal_flexion | SFInt32 | 000010110 | 0000010110 | 0000010110 | | [-I, +I] | 0 | |
| l_sternoclavicular_abduct | SFInt32 | 000010111 | 0000010111 | 0000010111 | | [-I, +I] | 0 | |
| r_sternoclavicular_abduct | SFInt32 | 000011000 | 0000011000 | 0000011000 | | [-I, +I] | 0 | |
| l_sternoclavicular_rotate | SFInt32 | 000011001 | 0000011001 | 0000011001 | | [-I, +I] | 0 | |
| r_sternoclavicular_rotate | SFInt32 | 000011010 | 0000011010 | 0000011010 | | [-I, +I] | 0 | |
| l_acromioclavicular_abduct | SFInt32 | 000011011 | 0000011011 | 0000011011 | | [-I, +I] | 0 | |
| r_acromioclavicular_abduct | SFInt32 | 000011100 | 0000011100 | 0000011100 | | [-I, +I] | 0 | |
| l_acromioclavicular_rotate | SFInt32 | 000011101 | 0000011101 | 0000011101 | | [-I, +I] | 0 | |
| r_acromioclavicular_rotate | SFInt32 | 000011110 | 0000011110 | 0000011110 | | [-I, +I] | 0 | |
| l_shoulder_flexion | SFInt32 | 000011111 | 0000011111 | 0000011111 | | [-I, +I] | 0 | |
| r_shoulder_flexion | SFInt32 | 000100000 | 000100000 | 000100000 | | [-I, +I] | 0 | |
| l_shoulder_abduct | SFInt32 | 000100001 | 000100001 | 000100001 | | [-I, +I] | 0 | |
| r_shoulder_abduct | SFInt32 | 000100010 | 000100010 | 000100010 | | [-I, +I] | 0 | |
| l_shoulder_twisting | SFInt32 | 000100011 | 000100011 | 000100011 | | [-I, +I] | 0 | |
| r_shoulder_twisting | SFInt32 | 000100100 | 000100100 | 000100100 | | [-I, +I] | 0 | |
| l_elbow_flexion | SFInt32 | 000100101 | 000100101 | 000100101 | | [-I, +I] | 0 | |
| r_elbow_flexion | SFInt32 | 000100110 | 000100110 | 000100110 | | [-I, +I] | 0 | |
| l_elbow_twisting | SFInt32 | 000100111 | 000100111 | 000100111 | | [-I, +I] | 0 | |
| r_elbow_twisting | SFInt32 | 000101000 | 000101000 | 000101000 | | [-I, +I] | 0 | |
| l_wrist_flexion | SFInt32 | 000101001 | 000101001 | 000101001 | | [-I, +I] | 0 | |
| r_wrist_flexion | SFInt32 | 000101010 | 000101010 | 000101010 | | [-I, +I] | 0 | |
| l_wrist_pivot | SFInt32 | 000101011 | 000101011 | 000101011 | | [-I, +I] | 0 | |
| r_wrist_pivot | SFInt32 | 000101100 | 000101100 | 000101100 | | [-I, +I] | 0 | |
| l_wrist_twisting | SFInt32 | 000101101 | 000101101 | 000101101 | | [-I, +I] | 0 | |
| r_wrist_twisting | SFInt32 | 000101110 | 000101110 | 000101110 | | [-I, +I] | 0 | |
| Skullbase_roll | SFInt32 | 000101111 | 000101111 | 000101111 | | [-I, +I] | 0 | |
| Skullbase_torsion | SFInt32 | 000110000 | 000110000 | 000110000 | | [-I, +I] | 0 | |
| Skullbase_tilt | SFInt32 | 000110001 | 000110001 | 000110001 | | [-I, +I] | 0 | |
| vc1roll | SFInt32 | 000110010 | 000110010 | 000110010 | | [-I, +I] | 0 | |
| vc1torsion | SFInt32 | 000110011 | 000110011 | 000110011 | | [-I, +I] | 0 | |
| vc1tilt | SFInt32 | 000110100 | 000110100 | 000110100 | | [-I, +I] | 0 | |
| vc2roll | SFInt32 | 000110101 | 000110101 | 000110101 | | [-I, +I] | 0 | |
| vc2torsion | SFInt32 | 000110110 | 000110110 | 000110110 | | [-I, +I] | 0 | |
| vc2tilt | SFInt32 | 000110111 | 000110111 | 000110111 | | [-I, +I] | 0 | |
| vc3roll | SFInt32 | 000111000 | 000111000 | 000111000 | | [-I, +I] | 0 | |

| | | | | | | | | |
|-------------|---------|-----------|-----------|-----------|--|----------|---|--|
| vc3torsion | SFInt32 | 000111001 | 000111001 | 000111001 | | [-I, +I] | 0 | |
| vc3tilt | SFInt32 | 000111010 | 000111010 | 000111010 | | [-I, +I] | 0 | |
| vc4roll | SFInt32 | 000111011 | 000111011 | 000111011 | | [-I, +I] | 0 | |
| vc4torsion | SFInt32 | 000111100 | 000111100 | 000111100 | | [-I, +I] | 0 | |
| vc4tilt | SFInt32 | 000111101 | 000111101 | 000111101 | | [-I, +I] | 0 | |
| vc5roll | SFInt32 | 000111110 | 000111110 | 000111110 | | [-I, +I] | 0 | |
| vc5torsion | SFInt32 | 000111111 | 000111111 | 000111111 | | [-I, +I] | 0 | |
| vc5tilt | SFInt32 | 001000000 | 001000000 | 001000000 | | [-I, +I] | 0 | |
| vc6roll | SFInt32 | 001000001 | 001000001 | 001000001 | | [-I, +I] | 0 | |
| vc6torsion | SFInt32 | 001000010 | 001000010 | 001000010 | | [-I, +I] | 0 | |
| vc6tilt | SFInt32 | 001000011 | 001000011 | 001000011 | | [-I, +I] | 0 | |
| vc7roll | SFInt32 | 001000100 | 001000100 | 001000100 | | [-I, +I] | 0 | |
| vc7torsion | SFInt32 | 001000101 | 001000101 | 001000101 | | [-I, +I] | 0 | |
| vc7tilt | SFInt32 | 001000110 | 001000110 | 001000110 | | [-I, +I] | 0 | |
| vt1roll | SFInt32 | 001000111 | 001000111 | 001000111 | | [-I, +I] | 0 | |
| vt1torsion | SFInt32 | 001001000 | 001001000 | 001001000 | | [-I, +I] | 0 | |
| vt1tilt | SFInt32 | 001001001 | 001001001 | 001001001 | | [-I, +I] | 0 | |
| vt2roll | SFInt32 | 001001010 | 001001010 | 001001010 | | [-I, +I] | 0 | |
| vt2torsion | SFInt32 | 001001011 | 001001011 | 001001011 | | [-I, +I] | 0 | |
| vt2tilt | SFInt32 | 001001100 | 001001100 | 001001100 | | [-I, +I] | 0 | |
| vt3roll | SFInt32 | 001001101 | 001001101 | 001001101 | | [-I, +I] | 0 | |
| vt3torsion | SFInt32 | 001001110 | 001001110 | 001001110 | | [-I, +I] | 0 | |
| vt3tilt | SFInt32 | 001001111 | 001001111 | 001001111 | | [-I, +I] | 0 | |
| vt4roll | SFInt32 | 001010000 | 001010000 | 001010000 | | [-I, +I] | 0 | |
| vt4torsion | SFInt32 | 001010001 | 001010001 | 001010001 | | [-I, +I] | 0 | |
| vt4tilt | SFInt32 | 001010010 | 001010010 | 001010010 | | [-I, +I] | 0 | |
| vt5roll | SFInt32 | 001010011 | 001010011 | 001010011 | | [-I, +I] | 0 | |
| vt5torsion | SFInt32 | 001010100 | 001010100 | 001010100 | | [-I, +I] | 0 | |
| vt5tilt | SFInt32 | 001010101 | 001010101 | 001010101 | | [-I, +I] | 0 | |
| vt6roll | SFInt32 | 001010110 | 001010110 | 001010110 | | [-I, +I] | 0 | |
| vt6torsion | SFInt32 | 001010111 | 001010111 | 001010111 | | [-I, +I] | 0 | |
| vt6tilt | SFInt32 | 001011000 | 001011000 | 001011000 | | [-I, +I] | 0 | |
| vt7roll | SFInt32 | 001011001 | 001011001 | 001011001 | | [-I, +I] | 0 | |
| vt7torsion | SFInt32 | 001011010 | 001011010 | 001011010 | | [-I, +I] | 0 | |
| vt7tilt | SFInt32 | 001011011 | 001011011 | 001011011 | | [-I, +I] | 0 | |
| vt8roll | SFInt32 | 001011100 | 001011100 | 001011100 | | [-I, +I] | 0 | |
| vt8torsion | SFInt32 | 001011101 | 001011101 | 001011101 | | [-I, +I] | 0 | |
| vt8tilt | SFInt32 | 001011110 | 001011110 | 001011110 | | [-I, +I] | 0 | |
| vt9roll | SFInt32 | 001011111 | 001011111 | 001011111 | | [-I, +I] | 0 | |
| vt9torsion | SFInt32 | 001100000 | 001100000 | 001100000 | | [-I, +I] | 0 | |
| vt9tilt | SFInt32 | 001100001 | 001100001 | 001100001 | | [-I, +I] | 0 | |
| vt10roll | SFInt32 | 001100010 | 001100010 | 001100010 | | [-I, +I] | 0 | |
| vt10torsion | SFInt32 | 001100011 | 001100011 | 001100011 | | [-I, +I] | 0 | |
| vt10tilt | SFInt32 | 001100100 | 001100100 | 001100100 | | [-I, +I] | 0 | |
| vt11roll | SFInt32 | 001100101 | 001100101 | 001100101 | | [-I, +I] | 0 | |
| vt11torsion | SFInt32 | 001100110 | 001100110 | 001100110 | | [-I, +I] | 0 | |
| vt11tilt | SFInt32 | 001100111 | 001100111 | 001100111 | | [-I, +I] | 0 | |
| vt12roll | SFInt32 | 001101000 | 001101000 | 001101000 | | [-I, +I] | 0 | |
| vt12torsion | SFInt32 | 001101001 | 001101001 | 001101001 | | [-I, +I] | 0 | |
| vt12tilt | SFInt32 | 001101010 | 001101010 | 001101010 | | [-I, +I] | 0 | |
| vl1roll | SFInt32 | 001101011 | 001101011 | 001101011 | | [-I, +I] | 0 | |
| vl1torsion | SFInt32 | 001101100 | 001101100 | 001101100 | | [-I, +I] | 0 | |
| vl1tilt | SFInt32 | 001101101 | 001101101 | 001101101 | | [-I, +I] | 0 | |
| vl2roll | SFInt32 | 001101110 | 001101110 | 001101110 | | [-I, +I] | 0 | |
| vl2torsion | SFInt32 | 001101111 | 001101111 | 001101111 | | [-I, +I] | 0 | |
| vl2tilt | SFInt32 | 001110000 | 001110000 | 001110000 | | [-I, +I] | 0 | |
| vl3roll | SFInt32 | 001110001 | 001110001 | 001110001 | | [-I, +I] | 0 | |
| vl3torsion | SFInt32 | 001110010 | 001110010 | 001110010 | | [-I, +I] | 0 | |
| vl3tilt | SFInt32 | 001110011 | 001110011 | 001110011 | | [-I, +I] | 0 | |
| vl4roll | SFInt32 | 001110100 | 001110100 | 001110100 | | [-I, +I] | 0 | |
| vl4torsion | SFInt32 | 001110101 | 001110101 | 001110101 | | [-I, +I] | 0 | |
| vl4tilt | SFInt32 | 001110110 | 001110110 | 001110110 | | [-I, +I] | 0 | |

| | | | | | | | | | |
|--------------------------|---------|-----------|-----------|-----------|--|----------|---|--|--|
| vl5roll | SFInt32 | 001110111 | 001110111 | 001110111 | | [-I, +I] | 0 | | |
| vl5torsion | SFInt32 | 001111000 | 001111000 | 001111000 | | [-I, +I] | 0 | | |
| vl5tilt | SFInt32 | 001111001 | 001111001 | 001111001 | | [-I, +I] | 0 | | |
| l_pinky0	flexion | SFInt32 | 001111010 | 001111010 | 001111010 | | [-I, +I] | 0 | | |
| r_pinky0	flexion | SFInt32 | 001111011 | 001111011 | 001111011 | | [-I, +I] | 0 | | |
| l_pinky1	flexion | SFInt32 | 001111100 | 001111100 | 001111100 | | [-I, +I] | 0 | | |
| r_pinky1	flexion | SFInt32 | 001111101 | 001111101 | 001111101 | | [-I, +I] | 0 | | |
| l_pinky1	pivot | SFInt32 | 001111110 | 001111110 | 001111110 | | [-I, +I] | 0 | | |
| r_pinky1	pivot | SFInt32 | 001111111 | 001111111 | 001111111 | | [-I, +I] | 0 | | |
| l_pinky1_twisting | SFInt32 | 010000000 | 010000000 | 010000000 | | [-I, +I] | 0 | | |
| r_pinky1_twisting | SFInt32 | 010000001 | 010000001 | 010000001 | | [-I, +I] | 0 | | |
| l_pinky2	flexion | SFInt32 | 010000010 | 010000010 | 010000010 | | [-I, +I] | 0 | | |
| r_pinky2	flexion | SFInt32 | 010000011 | 010000011 | 010000011 | | [-I, +I] | 0 | | |
| l_pinky3	flexion | SFInt32 | 010000100 | 010000100 | 010000100 | | [-I, +I] | 0 | | |
| r_pinky3	flexion | SFInt32 | 010000101 | 010000101 | 010000101 | | [-I, +I] | 0 | | |
| l_ring0	flexion | SFInt32 | 010000110 | 010000110 | 010000110 | | [-I, +I] | 0 | | |
| r_ring0	flexion | SFInt32 | 010000111 | 010000111 | 010000111 | | [-I, +I] | 0 | | |
| l_ring1	flexion | SFInt32 | 010001000 | 010001000 | 010001000 | | [-I, +I] | 0 | | |
| r_ring1	flexion | SFInt32 | 010001001 | 010001001 | 010001001 | | [-I, +I] | 0 | | |
| l_ring1	pivot | SFInt32 | 010001010 | 010001010 | 010001010 | | [-I, +I] | 0 | | |
| r_ring1	pivot | SFInt32 | 010001011 | 010001011 | 010001011 | | [-I, +I] | 0 | | |
| l_ring1_twisting | SFInt32 | 010001100 | 010001100 | 010001100 | | [-I, +I] | 0 | | |
| r_ring1_twisting | SFInt32 | 010001101 | 010001101 | 010001101 | | [-I, +I] | 0 | | |
| l_ring2	flexion | SFInt32 | 010001110 | 010001110 | 010001110 | | [-I, +I] | 0 | | |
| r_ring2	flexion | SFInt32 | 010001111 | 010001111 | 010001111 | | [-I, +I] | 0 | | |
| l_ring3	flexion | SFInt32 | 010010000 | 010010000 | 010010000 | | [-I, +I] | 0 | | |
| r_ring3	flexion | SFInt32 | 010010001 | 010010001 | 010010001 | | [-I, +I] | 0 | | |
| l_middle0	flexion | SFInt32 | 010010010 | 010010010 | 010010010 | | [-I, +I] | 0 | | |
| r_middle0	flexion | SFInt32 | 010010011 | 010010011 | 010010011 | | [-I, +I] | 0 | | |
| l_middle1	flexion | SFInt32 | 010010100 | 010010100 | 010010100 | | [-I, +I] | 0 | | |
| r_middle1	flexion | SFInt32 | 010010101 | 010010101 | 010010101 | | [-I, +I] | 0 | | |
| l_middle1	pivot | SFInt32 | 010010110 | 010010110 | 010010110 | | [-I, +I] | 0 | | |
| r_middle1	pivot | SFInt32 | 010010111 | 010010111 | 010010111 | | [-I, +I] | 0 | | |
| l_middle1_twisting | SFInt32 | 010011000 | 010011000 | 010011000 | | [-I, +I] | 0 | | |
| r_middle1_twisting | SFInt32 | 010011001 | 010011001 | 010011001 | | [-I, +I] | 0 | | |
| l_middle2	flexion | SFInt32 | 010011010 | 010011010 | 010011010 | | [-I, +I] | 0 | | |
| r_middle2	flexion | SFInt32 | 010011011 | 010011011 | 010011011 | | [-I, +I] | 0 | | |
| l_middle3	flexion | SFInt32 | 010011100 | 010011100 | 010011100 | | [-I, +I] | 0 | | |
| r_middle3	flexion | SFInt32 | 010011101 | 010011101 | 010011101 | | [-I, +I] | 0 | | |
| l_index0	flexion | SFInt32 | 010011110 | 010011110 | 010011110 | | [-I, +I] | 0 | | |
| r_index0	flexion | SFInt32 | 010011111 | 010011111 | 010011111 | | [-I, +I] | 0 | | |
| l_index1	flexion | SFInt32 | 010100000 | 010100000 | 010100000 | | [-I, +I] | 0 | | |
| r_index1	flexion | SFInt32 | 010100001 | 010100001 | 010100001 | | [-I, +I] | 0 | | |
| l_index1	pivot | SFInt32 | 010100010 | 010100010 | 010100010 | | [-I, +I] | 0 | | |
| r_index1	pivot | SFInt32 | 010100011 | 010100011 | 010100011 | | [-I, +I] | 0 | | |
| l_index1_twisting | SFInt32 | 010100100 | 010100100 | 010100100 | | [-I, +I] | 0 | | |
| r_index1_twisting | SFInt32 | 010100101 | 010100101 | 010100101 | | [-I, +I] | 0 | | |
| l_index2	flexion | SFInt32 | 010100110 | 010100110 | 010100110 | | [-I, +I] | 0 | | |
| r_index2	flexion | SFInt32 | 010100111 | 010100111 | 010100111 | | [-I, +I] | 0 | | |
| l_index3	flexion | SFInt32 | 010101000 | 010101000 | 010101000 | | [-I, +I] | 0 | | |
| r_index3	flexion | SFInt32 | 010101001 | 010101001 | 010101001 | | [-I, +I] | 0 | | |
| l_thumb1	flexion | SFInt32 | 010101010 | 010101010 | 010101010 | | [-I, +I] | 0 | | |
| r_thumb1	flexion | SFInt32 | 010101011 | 010101011 | 010101011 | | [-I, +I] | 0 | | |
| l_thumb1	pivot | SFInt32 | 010101100 | 010101100 | 010101100 | | [-I, +I] | 0 | | |
| r_thumb1	pivot | SFInt32 | 010101101 | 010101101 | 010101101 | | [-I, +I] | 0 | | |
| l_thumb1_twisting | SFInt32 | 010101110 | 010101110 | 010101110 | | [-I, +I] | 0 | | |
| r_thumb1_twisting | SFInt32 | 010101111 | 010101111 | 010101111 | | [-I, +I] | 0 | | |
| l_thumb2	flexion | SFInt32 | 010110000 | 010110000 | 010110000 | | [-I, +I] | 0 | | |
| r_thumb2	flexion | SFInt32 | 010110001 | 010110001 | 010110001 | | [-I, +I] | 0 | | |
| l_thumb3	flexion | SFInt32 | 010110010 | 010110010 | 010110010 | | [-I, +I] | 0 | | |
| r_thumb3	flexion | SFInt32 | 010110011 | 010110011 | 010110011 | | [-I, +I] | 0 | | |
| humanoidRoot_tr_vertical | SFInt32 | 010110100 | 010110100 | 010110100 | | [-I, +I] | 0 | | |

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|---------------------------|---------|-----------|-----------|-----------|--|----------|---|--|
| humanoidRoot_tr_lateral | SFInt32 | 010110101 | 010110101 | 010110101 | | [-I, +I] | 0 | |
| humanoidRoot_tr_frontal | SFInt32 | 010110110 | 010110110 | 010110110 | | [-I, +I] | 0 | |
| humanoidRoot_rt_body_turn | SFInt32 | 010110111 | 010110111 | 010110111 | | [-I, +I] | 0 | |
| humanoidRoot_rt_body_roll | SFInt32 | 010111000 | 010111000 | 010111000 | | [-I, +I] | 0 | |
| humanoidRoot_rt_body_tilt | SFInt32 | 010111001 | 010111001 | 010111001 | | [-I, +I] | 0 | |
| extensionBap187 | SFInt32 | 010111010 | 010111010 | 010111010 | | [-I, +I] | 0 | |
| extensionBap188 | SFInt32 | 010111011 | 010111011 | 010111011 | | [-I, +I] | 0 | |
| extensionBap189 | SFInt32 | 010111100 | 010111100 | 010111100 | | [-I, +I] | 0 | |
| extensionBap190 | SFInt32 | 010111101 | 010111101 | 010111101 | | [-I, +I] | 0 | |
| extensionBap191 | SFInt32 | 010111110 | 010111110 | 010111110 | | [-I, +I] | 0 | |
| extensionBap192 | SFInt32 | 010111111 | 010111111 | 010111111 | | [-I, +I] | 0 | |
| extensionBap193 | SFInt32 | 011000000 | 011000000 | 011000000 | | [-I, +I] | 0 | |
| extensionBap194 | SFInt32 | 011000001 | 011000001 | 011000001 | | [-I, +I] | 0 | |
| extensionBap195 | SFInt32 | 011000010 | 011000010 | 011000010 | | [-I, +I] | 0 | |
| extensionBap196 | SFInt32 | 011000011 | 011000011 | 011000011 | | [-I, +I] | 0 | |
| extensionBap197 | SFInt32 | 011000100 | 011000100 | 011000100 | | [-I, +I] | 0 | |
| extensionBap198 | SFInt32 | 011000101 | 011000101 | 011000101 | | [-I, +I] | 0 | |
| extensionBap199 | SFInt32 | 011000110 | 011000110 | 011000110 | | [-I, +I] | 0 | |
| extensionBap200 | SFInt32 | 011000111 | 011000111 | 011000111 | | [-I, +I] | 0 | |
| extensionBap201 | SFInt32 | 011001000 | 011001000 | 011001000 | | [-I, +I] | 0 | |
| extensionBap202 | SFInt32 | 011001001 | 011001001 | 011001001 | | [-I, +I] | 0 | |
| extensionBap203 | SFInt32 | 011001010 | 011001010 | 011001010 | | [-I, +I] | 0 | |
| extensionBap204 | SFInt32 | 011001011 | 011001011 | 011001011 | | [-I, +I] | 0 | |
| extensionBap205 | SFInt32 | 011001100 | 011001100 | 011001100 | | [-I, +I] | 0 | |
| extensionBap206 | SFInt32 | 011001101 | 011001101 | 011001101 | | [-I, +I] | 0 | |
| extensionBap207 | SFInt32 | 011001110 | 011001110 | 011001110 | | [-I, +I] | 0 | |
| extensionBap208 | SFInt32 | 011001111 | 011001111 | 011001111 | | [-I, +I] | 0 | |
| extensionBap209 | SFInt32 | 011010000 | 011010000 | 011010000 | | [-I, +I] | 0 | |
| extensionBap210 | SFInt32 | 011010001 | 011010001 | 011010001 | | [-I, +I] | 0 | |
| extensionBap211 | SFInt32 | 011010010 | 011010010 | 011010010 | | [-I, +I] | 0 | |
| extensionBap212 | SFInt32 | 011010011 | 011010011 | 011010011 | | [-I, +I] | 0 | |
| extensionBap213 | SFInt32 | 011010100 | 011010100 | 011010100 | | [-I, +I] | 0 | |
| extensionBap214 | SFInt32 | 011010101 | 011010101 | 011010101 | | [-I, +I] | 0 | |
| extensionBap215 | SFInt32 | 011010110 | 011010110 | 011010110 | | [-I, +I] | 0 | |
| extensionBap216 | SFInt32 | 011010111 | 011010111 | 011010111 | | [-I, +I] | 0 | |
| extensionBap217 | SFInt32 | 011011000 | 011011000 | 011011000 | | [-I, +I] | 0 | |
| extensionBap218 | SFInt32 | 011011001 | 011011001 | 011011001 | | [-I, +I] | 0 | |
| extensionBap219 | SFInt32 | 011011010 | 011011010 | 011011010 | | [-I, +I] | 0 | |
| extensionBap220 | SFInt32 | 011011011 | 011011011 | 011011011 | | [-I, +I] | 0 | |
| extensionBap221 | SFInt32 | 011011100 | 011011100 | 011011100 | | [-I, +I] | 0 | |
| extensionBap222 | SFInt32 | 011011101 | 011011101 | 011011101 | | [-I, +I] | 0 | |
| extensionBap223 | SFInt32 | 011011110 | 011011110 | 011011110 | | [-I, +I] | 0 | |
| extensionBap224 | SFInt32 | 011011111 | 011011111 | 011011111 | | [-I, +I] | 0 | |
| extensionBap225 | SFInt32 | 011100000 | 011100000 | 011100000 | | [-I, +I] | 0 | |
| extensionBap226 | SFInt32 | 011100001 | 011100001 | 011100001 | | [-I, +I] | 0 | |
| extensionBap227 | SFInt32 | 011100010 | 011100010 | 011100010 | | [-I, +I] | 0 | |
| extensionBap228 | SFInt32 | 011100011 | 011100011 | 011100011 | | [-I, +I] | 0 | |
| extensionBap229 | SFInt32 | 011100100 | 011100100 | 011100100 | | [-I, +I] | 0 | |
| extensionBap230 | SFInt32 | 011100101 | 011100101 | 011100101 | | [-I, +I] | 0 | |
| extensionBap231 | SFInt32 | 011100110 | 011100110 | 011100110 | | [-I, +I] | 0 | |
| extensionBap232 | SFInt32 | 011100111 | 011100111 | 011100111 | | [-I, +I] | 0 | |
| extensionBap233 | SFInt32 | 011101000 | 011101000 | 011101000 | | [-I, +I] | 0 | |
| extensionBap234 | SFInt32 | 011101001 | 011101001 | 011101001 | | [-I, +I] | 0 | |
| extensionBap235 | SFInt32 | 011101010 | 011101010 | 011101010 | | [-I, +I] | 0 | |
| extensionBap236 | SFInt32 | 011101011 | 011101011 | 011101011 | | [-I, +I] | 0 | |
| extensionBap237 | SFInt32 | 011101100 | 011101100 | 011101100 | | [-I, +I] | 0 | |
| extensionBap238 | SFInt32 | 011101101 | 011101101 | 011101101 | | [-I, +I] | 0 | |
| extensionBap239 | SFInt32 | 011101110 | 011101110 | 011101110 | | [-I, +I] | 0 | |
| extensionBap240 | SFInt32 | 011101111 | 011101111 | 011101111 | | [-I, +I] | 0 | |
| extensionBap241 | SFInt32 | 011110000 | 011110000 | 011110000 | | [-I, +I] | 0 | |
| extensionBap242 | SFInt32 | 011110001 | 011110001 | 011110001 | | [-I, +I] | 0 | |
| extensionBap243 | SFInt32 | 011110010 | 011110010 | 011110010 | | [-I, +I] | 0 | |

| | | | | | | | | |
|-----------------|---------|-----------|-----------|-----------|--|----------|---|--|
| extensionBap244 | SFInt32 | 011110011 | 011110011 | 011110011 | | [−I, +I] | 0 | |
| extensionBap245 | SFInt32 | 011110100 | 011110100 | 011110100 | | [−I, +I] | 0 | |
| extensionBap246 | SFInt32 | 011110101 | 011110101 | 011110101 | | [−I, +I] | 0 | |
| extensionBap247 | SFInt32 | 011110110 | 011110110 | 011110110 | | [−I, +I] | 0 | |
| extensionBap248 | SFInt32 | 011110111 | 011110111 | 011110111 | | [−I, +I] | 0 | |
| extensionBap249 | SFInt32 | 011111000 | 011111000 | 011111000 | | [−I, +I] | 0 | |
| extensionBap250 | SFInt32 | 011111001 | 011111001 | 011111001 | | [−I, +I] | 0 | |
| extensionBap251 | SFInt32 | 011111010 | 011111010 | 011111010 | | [−I, +I] | 0 | |
| extensionBap252 | SFInt32 | 011111011 | 011111011 | 011111011 | | [−I, +I] | 0 | |
| extensionBap253 | SFInt32 | 011111100 | 011111100 | 011111100 | | [−I, +I] | 0 | |
| extensionBap254 | SFInt32 | 011111101 | 011111101 | 011111101 | | [−I, +I] | 0 | |
| extensionBap255 | SFInt32 | 011111110 | 011111110 | 011111110 | | [−I, +I] | 0 | |
| extensionBap256 | SFInt32 | 011111111 | 011111111 | 011111111 | | [−I, +I] | 0 | |
| extensionBap257 | SFInt32 | 100000000 | 100000000 | 100000000 | | [−I, +I] | 0 | |
| extensionBap258 | SFInt32 | 100000001 | 100000001 | 100000001 | | [−I, +I] | 0 | |
| extensionBap259 | SFInt32 | 100000010 | 100000010 | 100000010 | | [−I, +I] | 0 | |
| extensionBap260 | SFInt32 | 100000011 | 100000011 | 100000011 | | [−I, +I] | 0 | |
| extensionBap261 | SFInt32 | 100000100 | 100000100 | 100000100 | | [−I, +I] | 0 | |
| extensionBap262 | SFInt32 | 100000101 | 100000101 | 100000101 | | [−I, +I] | 0 | |
| extensionBap263 | SFInt32 | 100000110 | 100000110 | 100000110 | | [−I, +I] | 0 | |
| extensionBap264 | SFInt32 | 100000111 | 100000111 | 100000111 | | [−I, +I] | 0 | |
| extensionBap265 | SFInt32 | 100001000 | 100001000 | 100001000 | | [−I, +I] | 0 | |
| extensionBap266 | SFInt32 | 100001001 | 100001001 | 100001001 | | [−I, +I] | 0 | |
| extensionBap267 | SFInt32 | 100001010 | 100001010 | 100001010 | | [−I, +I] | 0 | |
| extensionBap268 | SFInt32 | 100001011 | 100001011 | 100001011 | | [−I, +I] | 0 | |
| extensionBap269 | SFInt32 | 100001100 | 100001100 | 100001100 | | [−I, +I] | 0 | |
| extensionBap270 | SFInt32 | 100001101 | 100001101 | 100001101 | | [−I, +I] | 0 | |
| extensionBap271 | SFInt32 | 100001110 | 100001110 | 100001110 | | [−I, +I] | 0 | |
| extensionBap272 | SFInt32 | 100001111 | 100001111 | 100001111 | | [−I, +I] | 0 | |
| extensionBap273 | SFInt32 | 100010000 | 100010000 | 100010000 | | [−I, +I] | 0 | |
| extensionBap274 | SFInt32 | 100010001 | 100010001 | 100010001 | | [−I, +I] | 0 | |
| extensionBap275 | SFInt32 | 100010010 | 100010010 | 100010010 | | [−I, +I] | 0 | |
| extensionBap276 | SFInt32 | 100010011 | 100010011 | 100010011 | | [−I, +I] | 0 | |
| extensionBap277 | SFInt32 | 100010100 | 100010100 | 100010100 | | [−I, +I] | 0 | |
| extensionBap278 | SFInt32 | 100010101 | 100010101 | 100010101 | | [−I, +I] | 0 | |
| extensionBap279 | SFInt32 | 100010110 | 100010110 | 100010110 | | [−I, +I] | 0 | |
| extensionBap280 | SFInt32 | 100010111 | 100010111 | 100010111 | | [−I, +I] | 0 | |
| extensionBap281 | SFInt32 | 100011000 | 100011000 | 100011000 | | [−I, +I] | 0 | |
| extensionBap282 | SFInt32 | 100011001 | 100011001 | 100011001 | | [−I, +I] | 0 | |
| extensionBap283 | SFInt32 | 100011010 | 100011010 | 100011010 | | [−I, +I] | 0 | |
| extensionBap284 | SFInt32 | 100011011 | 100011011 | 100011011 | | [−I, +I] | 0 | |
| extensionBap285 | SFInt32 | 100011100 | 100011100 | 100011100 | | [−I, +I] | 0 | |
| extensionBap286 | SFInt32 | 100011101 | 100011101 | 100011101 | | [−I, +I] | 0 | |
| extensionBap287 | SFInt32 | 100011110 | 100011110 | 100011110 | | [−I, +I] | 0 | |
| extensionBap288 | SFInt32 | 100011111 | 100011111 | 100011111 | | [−I, +I] | 0 | |
| extensionBap289 | SFInt32 | 100100000 | 100100000 | 100100000 | | [−I, +I] | 0 | |
| extensionBap290 | SFInt32 | 100100001 | 100100001 | 100100001 | | [−I, +I] | 0 | |
| extensionBap291 | SFInt32 | 100100010 | 100100010 | 100100010 | | [−I, +I] | 0 | |
| extensionBap292 | SFInt32 | 100100011 | 100100011 | 100100011 | | [−I, +I] | 0 | |
| extensionBap293 | SFInt32 | 100100100 | 100100100 | 100100100 | | [−I, +I] | 0 | |
| extensionBap294 | SFInt32 | 100100101 | 100100101 | 100100101 | | [−I, +I] | 0 | |
| extensionBap295 | SFInt32 | 100100110 | 100100110 | 100100110 | | [−I, +I] | 0 | |
| extensionBap296 | SFInt32 | 100100111 | 100100111 | 100100111 | | [−I, +I] | 0 | |

H.3.5 BDP

| BDP | SFWorldNode SFBDPNode | | | | | | 0110 10 | | |
|----------------|--------------------------|--------|-------|--------|--------|--------|------------|---|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| bodyDefTables | MFBBodyDefTableNode | 0 | 0 | 0 | | | | | |
| bodySceneGraph | MF3DNode | 1 | 1 | 1 | | | | | |

H.3.6 Body

| Body | SFWorldNode SF3DNode SF2DNode | | | | | | 0111 011 11 | | |
|-------------------|---|---------------|--------------|---------------|---------------|---------------|-------------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| bdp | SFBDPNode | 00 | 00 | 00 | | | | | |
| bap | SFBAPNode | 01 | 01 | 01 | | | | | |
| renderedBody | MF3DNode | 10 | 10 | 10 | | | | | |

H.3.7 BodyDefTable

| BodyDefTable | SFWorldNode SFBodyDefTableName | | | | | | 1000 10 | | |
|------------------------|---|---------------|--------------|---------------|---------------|---------------|------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| bodySceneGraphNodeName | SFString | 000 | 000 | 000 | | | | | |
| bapIDs | MFInt32 | 001 | 001 | 001 | | [1, 296] | 13,9 | | |
| vertexIds | MFInt32 | 010 | 010 | 010 | | [0, +I] | 0 | | |
| bapCombinations | MFInt32 | 011 | 011 | 011 | | [-I, +I] | 0 | | |
| displacements | MFVec3f | 100 | 100 | 100 | | | | | |
| numInterpolateKeys | SFInt32 | 101 | 101 | 101 | | [2, +I] | 0 | | |

H.3.8 BodySegmentConnectionHint

| BodySegmentConnectionHint | SFWorldNode SFBodySegmentConnectionHintNode | | | | | | 1001 10 | | |
|----------------------------------|--|---------------|--------------|---------------|---------------|---------------|------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| firstSegmentnodeName | SFString | 00 | 00 | 00 | | | | | |
| secondSegmentnodeName | SFString | 01 | 01 | 01 | | | | | |
| firstVertexIdList | MFInt32 | 10 | 10 | 10 | | [0, +I] | 0 | | |
| secondVertexIdList | MFInt32 | 11 | 11 | 11 | | [0, +I] | | | |

H.3.9 DirectiveSound

| DirectiveSound | SFWorldNode SF3DNode | | | | | | 1010 100 | | |
|-----------------------|---|---------------|--------------|---------------|---------------|-----------------|-------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| direction | SFVec3f | 0000 | 000 | 000 | 00 | [-I, +I] | 9 | 9 | |
| intensity | SFFloat | 0001 | 001 | 001 | 01 | [0, +I] | 0 | 7 | |
| location | SFVec3f | 0010 | 010 | 010 | 10 | [-I, +I] | 1 | 1 | |
| source | SFAudioNode | 0011 | 011 | 011 | | | | | |
| perceptualParameters | SFPerceptualParameterNode | 0100 | 100 | 100 | | | | | |
| roomEffect | SFBool | 0101 | 101 | 101 | | | | | |
| spatialize | SFBool | 0110 | 110 | 110 | | | | | |
| directivity | MFFloat | 0111 | | | | [-I, +I] | 0 | | |
| angles | MFFloat | 1000 | | | | [0, 3.14159265] | 6 | | |
| Frequency | MFFloat | 1001 | | | | [0, +I] | 0 | | |
| speedOfSound | SFFloat | 1010 | | | | [0, +I] | 1 | | |
| distance | SFFloat | 1011 | | | | [0, +I] | 0 | | |
| UseAirabs | SFBool | 1100 | | | | | | | |

H.3.10 Hierarchical3DMesh

| Hierarchical3DMesh | SFWorldNode SF3DNode | | | | | | 1011 101 | | |
|---------------------------|---|---------------|--------------|---------------|---------------|---------------|-------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| triangleBudget | SFInt32 | | 0 | | | [-I, +I] | 0 | | |
| level | SFFloat | 0 | 1 | 0 | | [-I, +I] | 0 | | |
| url | MFURL | 1 | | | | | | | |
| DoneLoading | SFBool | | | 1 | | | | | |

H.3.11 MaterialKey

| MaterialKey | SFWorldNode SFMaterialNode | | | | | | 1100 11 | | |
|--------------------|---|---------------|--------------|---------------|---------------|---------------|------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| isKeyed | SFBool | 000 | 000 | 000 | | | | | |
| isRGB | SFBool | 001 | 001 | 001 | | | | | |
| keyColor | SFColor | 010 | 010 | 010 | 00 | [0, 1] | 4 | 4 | |
| LowThreshold | SFFloat | 011 | 011 | 011 | 01 | [0, 1] | 4 | 8 | |
| highThreshold | SFFloat | 100 | 100 | 100 | 10 | [0, 1] | 4 | 8 | |
| transparency | SFFloat | 101 | 101 | 101 | 11 | [0, 1] | 4 | 8 | |

H.3.12 PerceptualParameters

| PerceptualParameters | SFWorldNode SFPercpetualParameterNode | | | | | | 1101 10 | | |
|-----------------------------|--|---------------|--------------|---------------|---------------|---------------|------------|----------|--|
| Field name | Field type | DEF id | IN id | OUT id | DYN id | [m, M] | Q | A | |
| sourcePresence | SFFloat | 00000 | 00000 | 00000 | 00000 | [-1, +1] | 0 | 7 | |
| sourceWarmth | SFFloat | 00001 | 00001 | 00001 | 00001 | [-1, +1] | 0 | 7 | |
| sourceBrilliance | SFFloat | 00010 | 00010 | 00010 | 00010 | [-1, +1] | 0 | 7 | |
| roomPresence | SFFloat | 00011 | 00011 | 00011 | 00011 | [-1, +1] | 0 | 7 | |
| runningReverberance | SFFloat | 00100 | 00100 | 00100 | 00100 | [-1, +1] | 0 | 7 | |
| envelopment | SFFloat | 00101 | 00101 | 00101 | 00101 | [-1, +1] | 0 | 7 | |
| lateReverberance | SFFloat | 00110 | 00110 | 00110 | 00110 | [-1, +1] | 0 | 7 | |
| heavyness | SFFloat | 00111 | 00111 | 00111 | 00111 | [-1, +1] | 0 | 7 | |
| liveness | SFFloat | 01000 | 01000 | 01000 | 01000 | [-1, +1] | 0 | 7 | |
| omniDirectivity | MFFloat | 01001 | 01001 | 01001 | 01001 | [-1, +1] | 0 | 7 | |
| directFilterGains | MFFloat | 01010 | 01010 | 01010 | 01010 | [-1, +1] | 0 | 7 | |
| inputFilterGains | MFFloat | 01011 | 01011 | 01011 | 01011 | [-1, +1] | 0 | 7 | |
| refDistance | SFFloat | 01100 | 01100 | 01100 | 01100 | [-1, +1] | 0 | 7 | |
| freqLow | SFFloat | 01101 | 01101 | 01101 | 01101 | [-1, +1] | 0 | 7 | |
| freqHigh | SFFloat | 01110 | 01110 | 01110 | 01110 | [-1, +1] | 0 | 7 | |
| timeLimit1 | SFTime | 01111 | 01111 | 01111 | 01111 | [-1, +1] | 0 | 0 | |
| timeLimit2 | SFTime | 10000 | 10000 | 10000 | 10000 | [-1, +1] | 0 | 0 | |
| timeLimit3 | SFTime | 10001 | 10001 | 10001 | 10001 | [-1, +1] | 0 | 0 | |
| modalDensity | SFTime | 10010 | 10010 | 10010 | 10010 | [-1, +1] | 0 | 0 | |

H.4 Node Definition Type Tables for extended node types

| Node Definition Type | Number of nodes | | | | |
|----------------------|-----------------|-----|----|-----|-----|
| Node name | nodeType | DEF | IN | OUT | DYN |

H.4.1 SF2DNode

| SF2DNode | 2 Nodes | | | | |
|-----------------------------------|----------------|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| ApplicationWindow | 10 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| Body | 11 | 2 DEF bits | 2 IN bits | 2 OUT bits | N bits |

H.4.2 SF3DNode

| SF3DNode | 4 Nodes | | | | |
|------------------------------------|----------------|------------|-----------|------------|------------|
| reserved | 000 | | | | |
| PROTO | 001 | | | | |
| AcousticScene | 010 | 3 DEF bits | 1 IN bits | 1 OUT bits | 1 DYN bits |
| Body | 011 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| DirectiveSound | 100 | 4 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| Hierarchical3DMesh | 101 | 1 DEF bits | 1 IN bits | 1 OUT bits | bits |

H.4.3 SFBAPEnd

| SFBAPEnd | | 1 Node | | | |
|---------------------|----|------------|-----------|------------|------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| BAP | 10 | 9 DEF bits | 9 IN bits | 9 OUT bits | bits |

H.4.4 SFBDPNode

| SFBDPNode | | 1 Node | | | |
|---------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| BDP | 10 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |

H.4.5 SFBodyDefTableNode

| SFBodyDefTableNode | | 1 Node | | | |
|------------------------------|----|------------|-----------|------------|--------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| BodyDefTable | 10 | 3 DEF bits | 3 IN bits | 3 OUT bits | N bits |

H.4.6 SFBodySegmentConnectionHintNode

| SFBodySegmentConnectionHintNode | | 1 Node | | | |
|---|----|------------|-----------|------------|------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| BodySegmentConnectionHint | 10 | 2 DEF bits | 2 IN bits | 2 OUT bits | bits |

H.4.7 SFMaterialNode

| SFMaterialNode | | 2 Nodes | | | |
|----------------------------------|----|------------|-----------|------------|------------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| AcousticMaterial | 10 | 4 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| MaterialKey | 11 | 3 DEF bits | 3 IN bits | 3 OUT bits | bits |

H.4.8 SFPerceptualParameterNode

| SFPerceptualParameterNode | | 1 Node | | | |
|--------------------------------------|----|------------|-----------|------------|------|
| reserved | 00 | | | | |
| PROTO | 01 | | | | |
| PerceptualParameters | 10 | 5 DEF bits | 5 IN bits | 5 OUT bits | bits |

H.4.9 SFWorldNode

| SFWorldNode | | 12 Nodes | | | |
|---|------|------------|-----------|------------|------------|
| reserved | 0000 | | | | |
| PROTO | 0001 | | | | |
| AcousticMaterial | 0010 | 4 DEF bits | 3 IN bits | 3 OUT bits | 3 DYN bits |
| AcousticScene | 0011 | 3 DEF bits | 1 IN bits | 1 OUT bits | 1 DYN bits |
| ApplicationWindow | 0100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| BAP | 0101 | 9 DEF bits | 9 IN bits | 9 OUT bits | 0 DYN bits |
| BDP | 0110 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| Body | 0111 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| BodyDefTable | 1000 | 3 DEF bits | 3 IN bits | 3 OUT bits | 0 DYN bits |
| BodySegmentConnectionHint | 1001 | 2 DEF bits | 2 IN bits | 2 OUT bits | 0 DYN bits |
| DirectiveSound | 1010 | 4 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| Hierarchical3DMesh | 1011 | 1 DEF bits | 1 IN bits | 1 OUT bits | 0 DYN bits |
| MaterialKey | 1100 | 3 DEF bits | 3 IN bits | 3 OUT bits | 2 DYN bits |
| PerceptualParameters | 1101 | 5 DEF bits | 5 IN bits | 5 OUT bits | 5 DYN bits |

Annex I (informative)

MPEG-4 Audio TTS application with Facial Animation

To clarify the basic architecture and operations of an MPEG-4 terminal when the MPEG-4 Audio Text-to-Speech Decoder is used with Facial Animation, application specific interpretations of the bitstream syntax and semantics of MPEG-4 Systems and MPEG-4 Audio are addressed here.

As this application has two different outputs including synthesized speech and animated face decoders, the TTS synthesizer and the face decoder should be incorporated. In addition to these decoders, a special component "Phoneme/bookmark-to-FAP converter" is used to animate the face synchronously with synthesized phonemes. As the TTS stream drives the face decoder, the Phoneme/bookmark-to-FAP converter generates FAPs with appropriate timing information. The speech synthesizer feeds phonemes and their duration to the Phoneme/bookmark-to-FAP converter. The MPEG-4 terminal is configured to associate a **Sound** node and a **Face** node through the **TTSsource** field of the **Face** node which may contain the **AudioSource** node of the TTS.

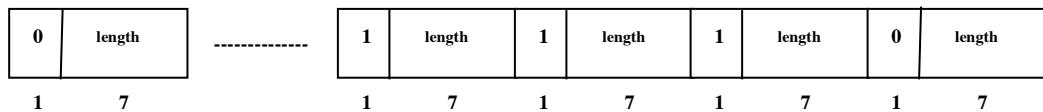
If the MPEG-4 terminal receives a **Face** node with a non-NUL **TTSsource** field, it connects the **Face** node to the **AudioSource** node as defined in this **TTSsource** field. The **AudioSource** node contains the MPEG-4 Audio Text-to-Speech. The MPEG-4 Audio Text-to-Speech Decoder communicates with the **Face** node using the **ttsFAPInterface** of the Phoneme/bookmark-to-FAP converter.

Annex J (informative)

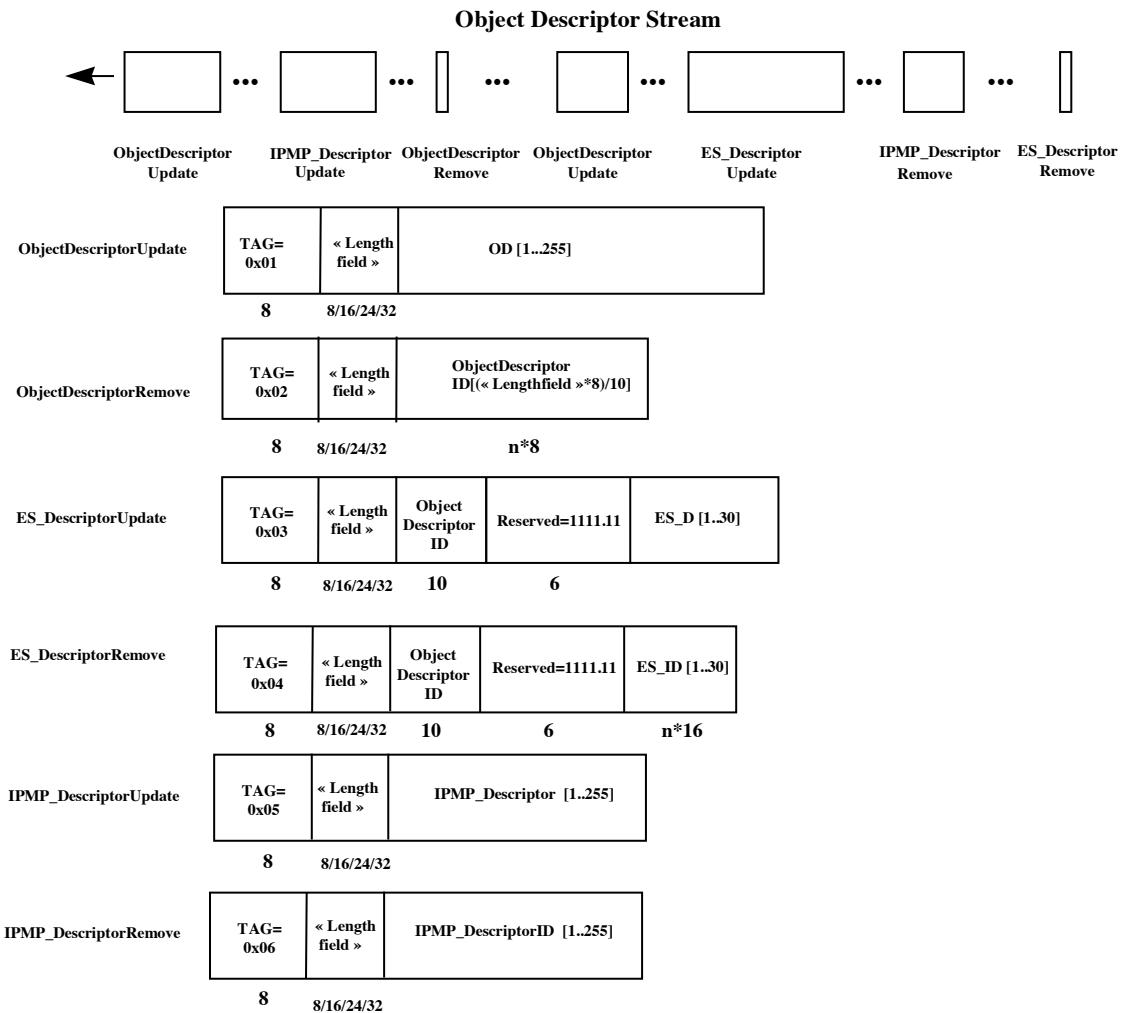
Graphical representation of object descriptor and sync layer syntax

J.1 Length encoding of descriptors and commands

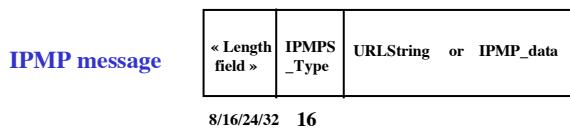
« Length field » : from one byte, up to four bytes



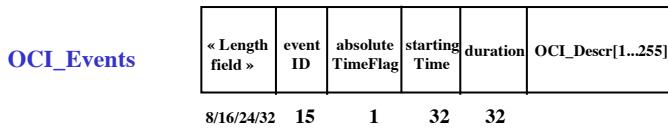
J.2 Object Descriptor Stream and OD commands



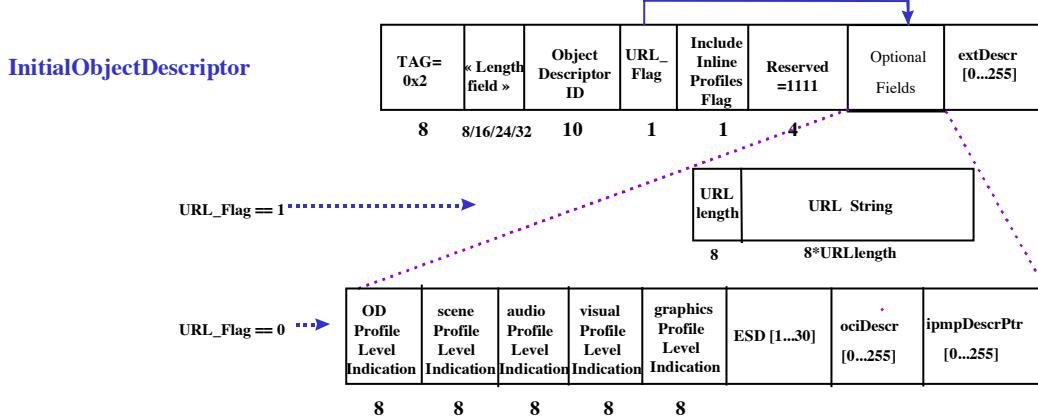
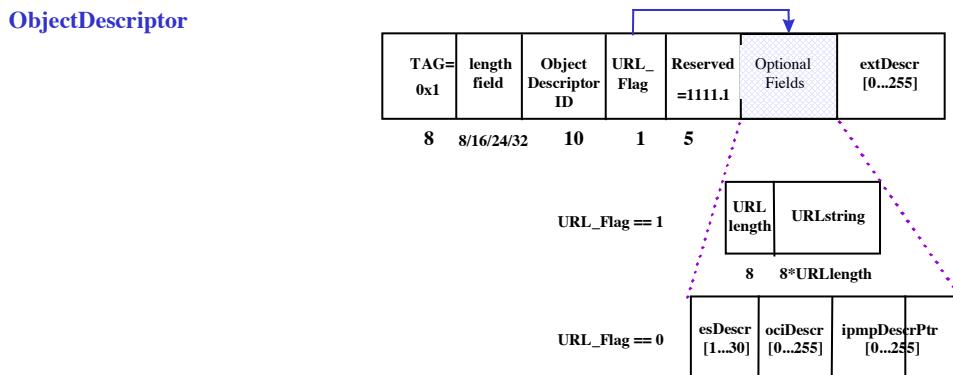
J.3 IPMP stream

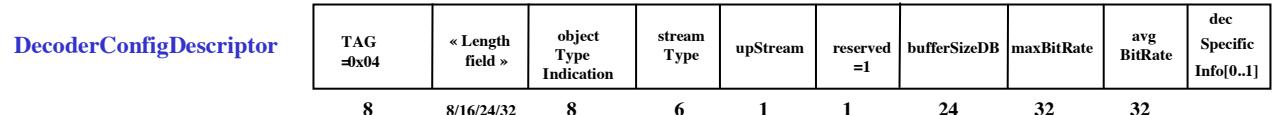
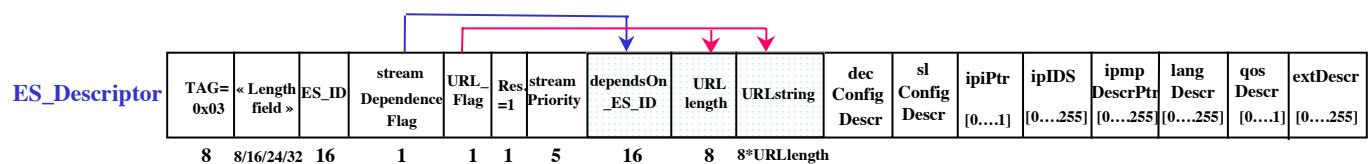


J.4 OCI stream

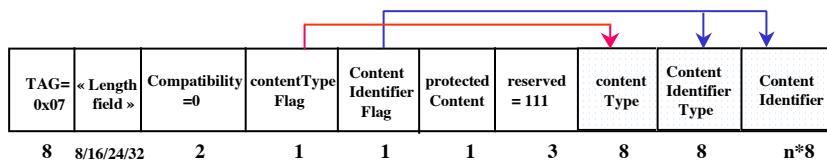


J.5 Object descriptor and its components

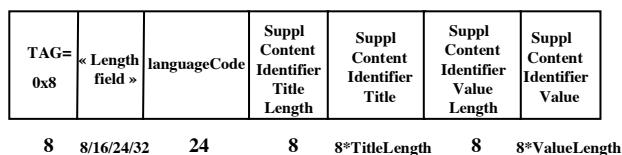




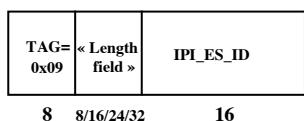
ContentIdentificationDescriptor

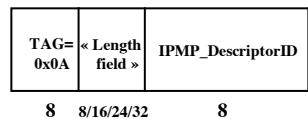
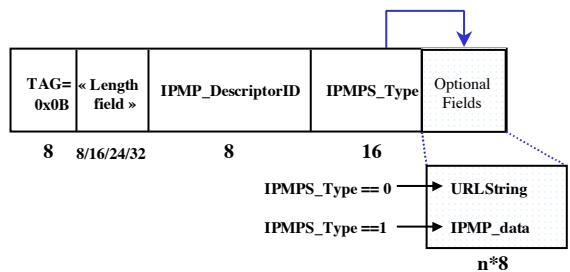
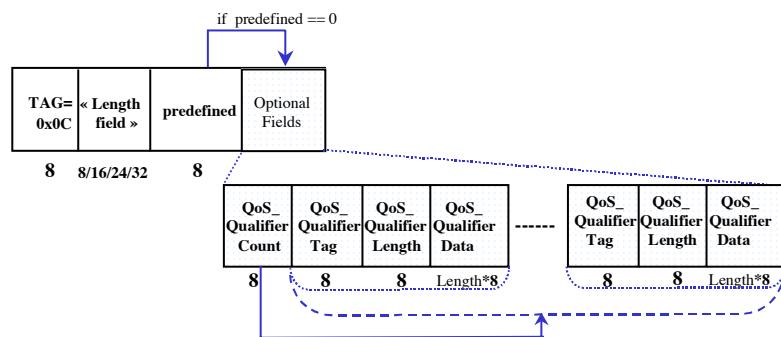
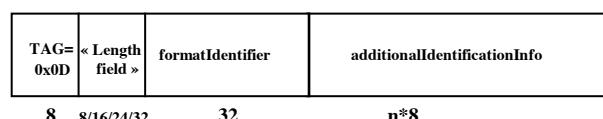


SupplementaryContentIdentificationDescriptor



IPI_DescriptorPointer



IPMP_DescriptorPointer**IPMPDescriptor****QoS_Descriptor****RegistrationDescriptor**

J.6 OCI Descriptors

ContentClassificationDescriptor

| | | | | |
|-----------|------------------|----------------------|---------------------|---------------------------|
| TAG= 0x40 | « Length field » | classificationEntity | classificationTable | contentClassificationData |
|-----------|------------------|----------------------|---------------------|---------------------------|

8 8/16/24/32 32 16 n*8

KeyWordDescriptor

| | | | | | | | | |
|-----------|------------------|--------------|---------------|----------------|--------------|-----|----------------|--------------|
| TAG= 0x41 | « Length field » | languageCode | keyWord Count | keyWord Length | keyWord[---] | ... | keyWord Length | keyWord[---] |
|-----------|------------------|--------------|---------------|----------------|--------------|-----|----------------|--------------|

8 8/16/24/32 24 8 8 8 8

If languageCode == latin → 8* keyWordLength 8* keyWordLength
 If languageCode != latin → 16*keyWordLength / 2 16*keyWordLength / 2

RatingDescriptor

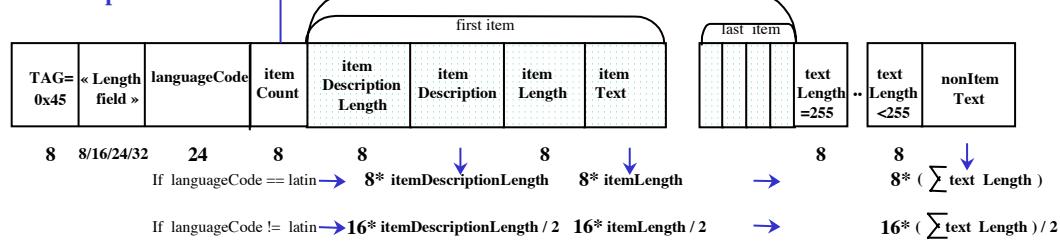
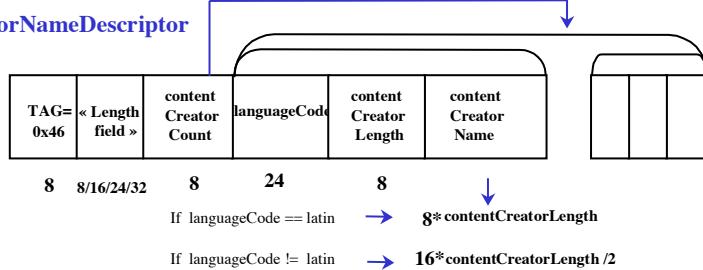
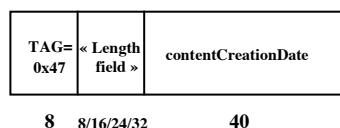
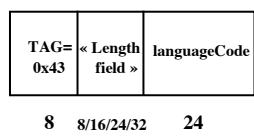
| | | | | |
|-----------|------------------|--------------|----------------|------------|
| TAG= 0x42 | « Length field » | ratingEntity | ratingCriteria | ratingInfo |
|-----------|------------------|--------------|----------------|------------|

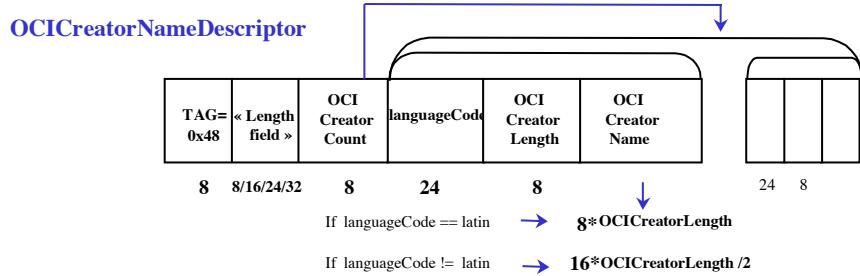
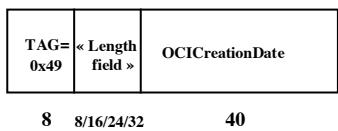
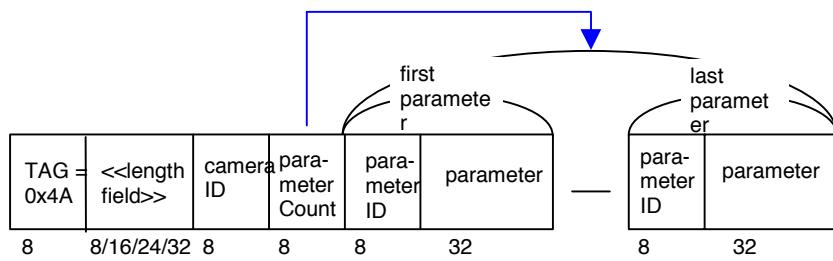
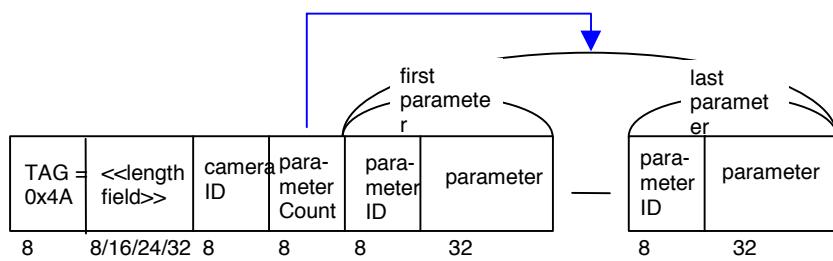
8 8/16/24/32 32 16 n*8

ShortTextualDescriptor

| | | | | | | |
|-----------|------------------|--------------|------------|-----------|------------|-----------|
| TAG= 0x44 | « Length field » | languageCode | nameLength | eventName | textLength | eventText |
|-----------|------------------|--------------|------------|-----------|------------|-----------|

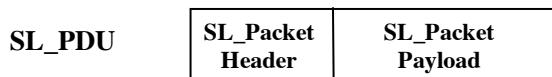
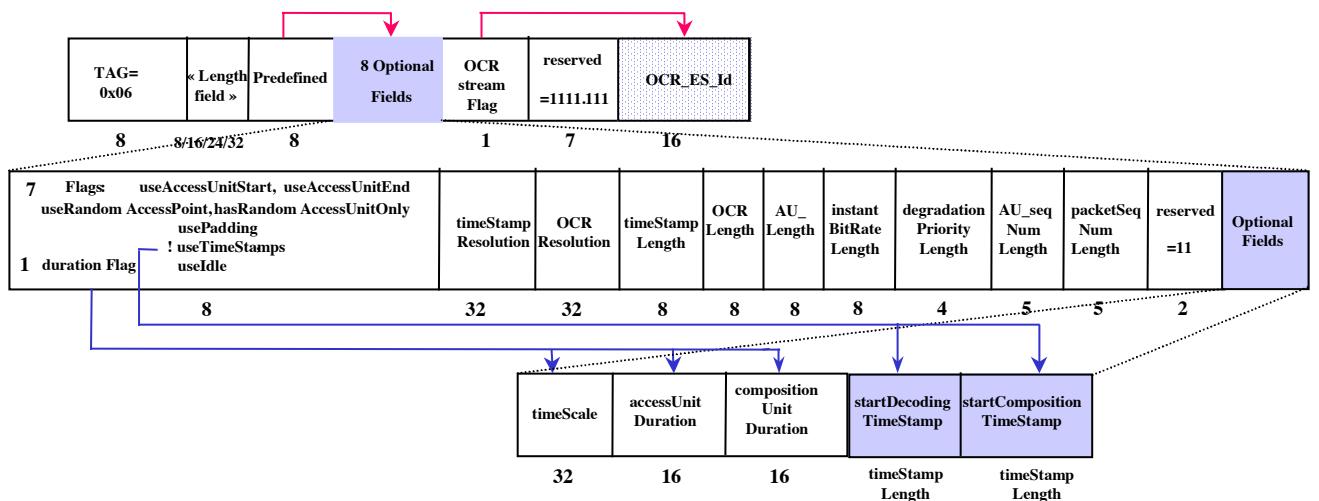
8 8/16/24/32 24 8 ↓ 8 ↓
 If languageCode == latin → 8* nameLength → 8* textLength
 If languageCode != latin → 16*nameLength / 2 → 16*textLength / 2

ExpandedTextualDescriptor**ContentCreatorNameDescriptor****ContentCreationDateDescriptor****LanguageDescriptor**

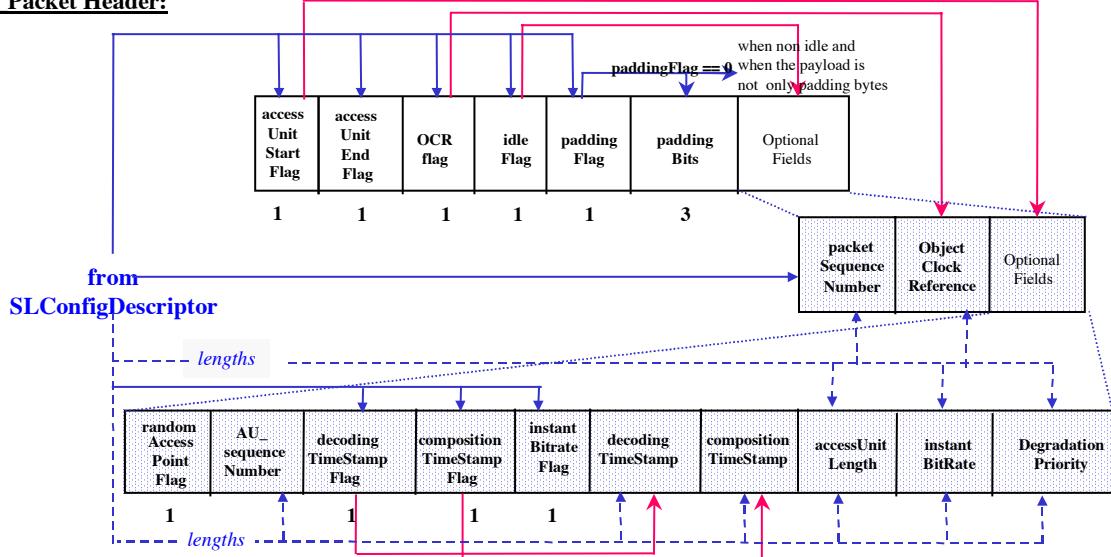
**OCICreationDateDescriptor****SmpTECameraPositionDescriptor**

J.7 Sync layer configuration and syntax

SLConfigDescriptor



SL Packet Header:



SL Packet Payload:

according to padding flag and bits, it is either



Annex K

(informative)

Patent statements

The International Organization for Standardization and the International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this part of ISO/IEC 14496 may involve the use of patents.

ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent right have assured the ISO and IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patents right are registered with ISO and IEC. Information may be obtained from the companies listed below.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 14496 may be the subject of patent rights other than those identified in this annex. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

K.1 Patent Statements for Version 1

The table summarises the formal patent statements received and indicates the parts of the standard to which the statement applies. (S: Systems, V: Visual, A: Audio, R: Reference Software, D: DMIF) The list includes all organisations that have submitted informal patent statements. However, if no "X" is present, no formal patent statement has yet been received from that organisation.

| | Company | S | V | A | R | D |
|-----|------------------------------|---|---|---|---|---|
| 1. | Alcatel | x | x | x | x | x |
| 2. | AT&T | | | | | |
| 3. | BBC | x | x | x | x | x |
| 4. | Bosch | | x | x | x | |
| 5. | British Telecommunications | x | x | x | x | x |
| 6. | Canon | x | x | x | x | x |
| 7. | CCETT | x | x | x | x | x |
| 8. | Columbia University | x | x | x | x | x |
| 9. | Creative | x | | x | x | |
| 10. | CSELT | | | x | | |
| 11. | DEmoGraFX | | x | | x | |
| 12. | DirecTV | x | x | x | | |
| 13. | Dolby | x | x | x | x | x |
| 14. | EPFL | x | x | x | | |
| 15. | ETRI | x | x | x | x | x |
| 16. | FhG | x | x | x | x | x |
| 17. | France Telecom | x | x | x | x | x |
| 18. | Fujitsu Limited | x | x | x | x | x |
| 19. | GC Technology Corporation | x | x | x | | |
| 20. | General Instrument | | x | | x | |
| 21. | Hitachi | x | x | x | x | x |
| 22. | Hyundai | x | x | x | x | x |
| 23. | IBM | | | | | |
| 24. | Institut für Rundfunktechnik | x | x | x | | x |
| 25. | InterTrust | | | | | |
| 26. | JVC | x | x | x | x | x |

| | | | | | | |
|-----|------------------------|---|---|---|---|---|
| 27. | KDD Corporation | x | x | | | |
| 28. | KPN | x | x | x | x | x |
| 29. | LG Semicon | | | | | |
| 30. | Lucent | | | | | |
| 31. | Matsushita | x | x | x | x | x |
| 32. | Microsoft | x | x | x | x | x |
| 33. | MIT | | | | | |
| 34. | Mitsubishi | x | x | x | x | |
| 35. | Motorola | | x | | x | |
| 36. | NEC Corporation | x | x | x | x | x |
| 37. | NHK | x | x | x | x | x |
| 38. | Nokia | | x | x | x | |
| 39. | NTT | x | x | x | x | x |
| 40. | OKI | x | x | x | x | x |
| 41. | Philips | x | x | x | x | x |
| 42. | PictureTel Corporation | | x | | x | |
| 43. | Rockwell | x | x | x | x | x |
| 44. | Samsung | x | x | x | | |
| 45. | Sarnoff | x | x | x | x | x |
| 46. | Scientific Atlanta | x | x | x | x | x |
| 47. | Sharp | x | x | x | x | x |
| 48. | Siemens | x | x | x | | |
| 49. | Sony | x | x | x | x | x |
| 50. | Telenor | x | x | x | x | x |
| 51. | Teltec DCU | | x | | x | |
| 52. | Texas Instruments | | | | | |
| 53. | Thomson | x | x | x | | |
| 54. | Toshiba | | x | | | |
| 55. | Unisearch Ltd. | | x | | x | |
| 56. | Vector Vision | | x | | | |

K.2 Patent Statements for Version 2

The table summarises the patent statements received for Version 2 and indicates the parts of the Version 2 standard to which the statement applies. A Legend to interpret the table is given below.

Legend: The presence of a name of a company in the list below indicates that a patent statement has been received from that company

The presence of a cross indicates that the statement identifies the part of the MPEG-4 version 2 standard to which the statement applies

No cross in a line indicates that the statement does not identify which part of the standard the statement applies

| | Company | S | V | A | R | D |
|----|--------------------------------|---|---|---|---|---|
| 1. | Apple | x | | | x | |
| 2. | British Telecommunications | | | | | |
| 3. | Bosch | x | x | x | x | x |
| 4. | CCETT | x | x | x | x | x |
| 5. | Columbia Innovation Enterprise | x | x | x | x | x |
| 6. | DemoGraFX | x | x | x | x | x |
| 7. | DirecTV | x | x | x | | |
| 8. | Dolby | x | x | x | x | x |

| | | | | | | |
|-----|--|---|---|---|---|---|
| 9. | EPFL | X | X | | X | |
| 10. | France Telecom | X | X | X | X | X |
| 11. | Fraunhofer | | | X | X | |
| 12. | Fujitsu | | X | | X | |
| 13. | Hitachi | X | X | X | X | X |
| 14. | Hyundai | X | X | X | X | X |
| 15. | IBM | X | X | X | X | X |
| 16. | Intertrust | | | | | |
| 17. | JVC | X | X | X | X | X |
| 18. | KPN | | X | | | |
| 19. | Lucent | | | | | |
| 20. | Matsushita Electric Industrial Co., Ltd. | X | X | X | X | X |
| 21. | Microsoft | X | X | X | X | X |
| 22. | Mitsubishi | X | X | X | X | X |
| 23. | NEC | X | X | X | X | X |
| 24. | NHK | X | X | X | X | X |
| 25. | Nokia | X | X | X | X | X |
| 26. | NTT | | X | | | |
| 27. | NTT Mobile Communication Networks | | | X | | |
| 28. | OKI | X | X | | X | |
| 29. | Optibase | X | | | X | |
| 30. | Philips | | | | | |
| 31. | Samsung | X | X | X | X | |
| 32. | Sarnoff | X | X | X | X | X |
| 33. | Sharp | X | X | X | X | X |
| 34. | Siemens | X | X | X | X | X |
| 35. | Sony | X | X | X | X | X |
| 36. | Sun | X | | | | |
| 37. | Thomson | X | X | X | X | X |
| 38. | Toshiba | | X | | | |

Annex L (informative)

Elementary Stream Interface

The elementary stream interface (ESI) is a conceptual interface that specifies which data need to be exchanged between the entity that generates an elementary stream and the sync layer. Communication between the coding and sync layers cannot only include compressed media, but requires additional information such as time codes, length of access units, etc.

An implementation of ISO/IEC 14496-1, however, does not have to implement the elementary stream interface. It is possible to integrate parsing of the SL-packetized stream and media data decompression in one decoder entity. Note that even in this case the decoder receives a sequence of packets at its input through the DMIF Application Interface (see 10.3) rather than a data stream.

The interface to receive elementary stream data from the sync layer has a number of parameters that reflect the side information that has been retrieved while parsing the incoming SL-packetized stream:

*ESI.receiveData (ESdata, dataLength, idleFlag, objectClockReference, decodingTimeStamp,
compositionTimeStamp, accessUnitStartFlag, randomAccessFlag, accessUnitEndFlag,
accessUnitLength, degradationPriority, errorStatus)*

ESdata - a number of *dataLength* data bytes for this elementary stream

dataLength - the length in byte of *ESdata*

idleFlag – if set to one it indicates that this elementary stream will not produce further data for an undetermined period of time.

objectClockReference – contains a reading of the object time base valid for the point in time when the first byte of *ESdata* enters the decoder buffer.

decodingTimeStamp - the decoding time for the access unit to which this *ESdata* belongs

compositionTimeStamp - the composition time for the access unit to which this *ESdata* belongs

accessUnitStartFlag - indicates that the first byte of *ESdata* is the start of an access unit

randomAccessFlag - indicates that the first byte of *ESdata* is the start of an access unit allowing for random access

accessUnitEndFlag - indicates that the last byte of *ESdata* is the end of an access unit

accessUnitLength - the length of the access unit to which this *ESdata* belongs in byte

degradationPriority - indicates the degradation priority for this access unit

errorStatus - indicates whether *ESdata* is error free, possibly erroneous or whether data has been lost preceding the current *ESdata* bytes

A similar interface to send elementary stream data to the sync layer requires the following parameters that will subsequently be encoded on the sync layer:

*ESI.sendData (ESdata, dataLength, idleFlag, objectClockReference, decodingTimeStamp, compositionTimeStamp,
accessUnitStartFlag, randomAccessFlag, accessUnitEndFlag, accessUnitLength,
degradationPriority)*

ESdata - a number of *dataLength* data bytes for this elementary stream

dataLength - the length in byte of *ESdata*

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idleFlag – if set to one it indicates that this elementary stream will not produce further data for an undetermined period of time.

objectClockReference – contains a reading of the object time base valid for the point in time when the first byte of *ESdata* enters the decoder buffer.

decodingTimeStamp - the decoding time for the access unit to which this *ESdata* belongs

compositionTimeStamp - the composition time for the access unit to which this *ESdata* belongs

accessUnitStartFlag - indicates that the first byte of *ESdata* is the start of an access unit

randomAccessFlag - indicates that the first byte of *ESdata* is the start of an access unit allowing for random access

accessUnitEndFlag - indicates that the last byte of *ESdata* is the end of an access unit

accessUnitLength - the length of the access unit to which this *Esdata* belongs in byte

degradationPriority - indicates the degradation priority for this access unit

Annex M (Informative)

Definition of bodySceneGraph nodes

M.1 Introduction

This Annex includes the normative definitions of the nodes used in the **bodySceneGraph** field of the **BDP** node (see 9.4.2.17)

M.2 Detailed Semantics

The VRML working group on Humanoid Animation (H-Anim) is working on a standard specification of bodies. The **bodySceneGraph** syntax is strongly based on ISO/IEC 14772-1:1997/Amd.1.

The H-Anim specification contains 3 types of Nodes, among other nodes: **Joint** node describes the skeleton hierarchy of the body, **Segment** node describes the surface information of the body, **HumanoidInfo** node includes information about the model.

M.3 Overview

The human body consists of a number of segments (such as the forearm, hand and foot) which are connected to each other by joints (such as the elbow, wrist and ankle). In order for a decoder to animate a humanoid, it needs to obtain access to the joints and alter the joint angles.

Each segment of the body will typically be defined by children nodes of type **IndexedFaceSet**, and an application may need to alter the locations of the vertices in that mesh. The application may also need to obtain information about which vertices should be treated as a group for the purpose of deformation.

The **bodySceneGraph** field of a **BDP** node contains a set of **Joint** nodes that are arranged to form a hierarchy. Each **Joint** node can contain other **Joint** nodes, and may also contain a **Segment** node which describes the body part associated with that joint. Each **Segment** can also have a number of **Site** nodes, which define locations relative to the segment. **Sites** nodes can be used for attaching clothing and jewelry, and can be used as end-effectors for inverse kinematics applications. They can also be used to define eyepoints and viewpoint locations.

Each **Segment** node can have a number of **Displacer** nodes, which specify which vertices within the segment correspond to particular feature or configuration of vertices. The **bodySceneGraph** node also contains a single **Humanoid** node which stores human-readable data about the humanoid such as author and copyright information. That node also stores references to all the **Joint**, **Segment** and **Site** nodes, and serves as a "wrapper" for the humanoid. In addition, it provides a top-level Transform for positioning the humanoid in its environment.

Keyframe animation sequences can be stored in the same file, with the outputs of various interpolator nodes being ROUTED to the joints of the body. Alternatively, the file may include **Script** nodes which access the joints directly. In addition, applications can obtain references to the individual joints and segments from the **Humanoid** node. Such applications will typically animate the humanoid by setting the joint rotations through BAPs.

M.4 The Nodes

In order to simplify the creation of humanoids, several new node types are introduced. Each node is defined by a PROTO. The basic implementation of all the nodes is very straightforward, yet each provides enough flexibility to allow more advanced techniques to be used.

M.4.1 The Joint Node

Each joint in the body is represented by a **Joint** node. The implementation for a **Joint** is a **Transform** node, which is used to define the relationship of each body segment to its immediate parent.

The Joint node is also used to store other joint-specific information. In particular, a joint name is provided so that applications can identify each Joint node at runtime.

In addition, the Joint node may contain hints for inverse-kinematics systems that wish to control the H-Anim figure. These hints include the upper and lower joint limits, the orientation of the joint limits, and a stiffness/resistance value. Note that these limits are not enforced by any mechanism within the scene graph of the humanoid, and are provided for information purposes only. Use of this information and enforcement of the joint limits is up to the application.

The Joint PROTO looks like follows:

```
PROTO Joint [
    exposedField    SFString      name          ""
    exposedField    SFVec3f       center        0 0 0
    exposedField    SFRotation   rotation      0 0 1 0
    exposedField    SFVec3f       scale         1 1 1
    exposedField    SFRotation   scaleOrientation 0 0 1 0
    exposedField    SFVec3f       translation   0 0 0
    exposedField    MFFloat       ulimit        []
    exposedField    MFFloat       llimit        []
    exposedField    SFRotation   limitOrientation 0 0 1 0
    exposedField    MFFloat       stiffness     [ 1 1 1 ]
    exposedField    MFNode        children     []
]
```

NOTE - Most of the fields correspond to those of the Transform node. This is because the typical implementation of the Joint PROTO will be:

```
{
    Transform {
        translation IS translation
        rotation IS rotation
        scale IS scale
        scaleOrientation IS scaleOrientation
        center IS center
        children IS children
    }
}
```

The center exposedField gives the position of the Joint's center of rotation, relative to the root of the overall humanoid body description. Note that the center field is not intended to receive events. The locations of the joint centers are available by reading the center fields of the Joint nodes.

Since the locations of the joint centers are all in the same coordinate frame, the length of any segment can be determined by simply subtracting the locations of the joint centers. The exception will be segments at the ends of the fingers and toes, for which the Site locations within the Segment must be used (see the description of Sites below for details).

The ulimit and llimit fields of the Joint PROTO specify the upper and lower joint rotation limits. Both fields are three-element MFFloats containing separate values for the X, Y and Z rotation limits. The ulimit field stores the upper (i.e. maximum) values for rotation around the X, Y and Z axes. The llimit field stores the lower (i.e. minimum) values for rotation around those axes. Note that the default values for each of these fields is [], which means that the joint is assumed to be unconstrained.

The limitOrientation exposedField gives the orientation of the coordinate frame in which the ulimit and llimit values are to be interpreted. The limitOrientation describes the orientation of a local coordinate frame, relative to the Joint center position described by the center exposedField.

The stiffness exposedField, if present, contains values ranging between 0.0 and 1.0 which give the inverse kinematics system hints about the "willingness" of a joint to move a particular degree of freedom. For example, a Joint node's stiffness can be used in an arm joint chain to give preference to moving the left wrist and left elbow over moving the left shoulder, or it can be used within a single Joint node with multiple degrees of freedom to give preference to individual degrees of freedom. The larger the stiffness value, the more the joint will resist movement.

Each Joint should have a *DEF* name that matches the name field for that Joint, but with a distinguishing prefix in front of it. Only a single humanoid is contained within a **Body** node, the prefix should be "hanim_..." (for Humanoid Animation). For example, the left shoulder would have a DEF name of "hanim_l_shoulder".

The DEF name is used for static routing, which would typically connect the BAPs to segments, and define segment names for **bodyDefTables**. In addition, optionally, it may be used for connect **OrientationInterpolators** in the humanoid file to the joints.

It will occasionally be useful for the person creating a humanoid to be able to add additional joints to the body. The body remains humanoid in form, and is still generally expected to have the basic joints described later in this document. However, they may be thought of as a minimal set to which extensions may be added (such as a prehensile tail). See the section on Non-standard Joints and Segments. If necessary, some of the joints (such as the many vertebrae) may be omitted.

Each body segment is stored in a Segment node. The Segment node will typically be implemented as a **Group** node containing one or more **Shapes** or perhaps **Transform** nodes that position the body part within its coordinate system (see Annex, for details). The use of LOD nodes is recommended if the geometry of the Segment is complex.

```
PROTO Segment [
    exposedField SFString name        ""
    exposedField SFVec3f centerOfMass 0 0 0
    exposedField SFVec3f momentsOfInertia 1 1 1
    exposedField SFFloat mass         0
    exposedField MFNode children      [ ]
    exposedField SFNode coord        NULL
    exposedField MFNode displacers   [ ]
    eventIn MFNode addChildren
    eventIn MFNode removeChildren
]
```

This will typically be implemented as follows:

```
{
    Group {
        children IS children
        addChildren IS addChildren
        removeChildren IS removeChildren
    }
}
```

The fields except name are optional.

The mass is the total mass of the segment, and the centerOfMass is the location within the segment of its center of mass.

If **bodyDefTables** need to be used, the Segment node contains one **IndexedFaceSet** child that shall be used for these tables. The indices of vertices in the **IndexedFaceSet** node should correspond to the indices in **bodyDefTable** node.

M.4.2 The Humanoid Node

The Humanoid node is used to store human-readable data such as author and copyright information, as well as to store references to the joints, segments and views and to serve as a container for the entire humanoid. It also provides a convenient way of moving the humanoid through its environment.

```
PROTO Humanoid [
    exposedField SFString name        ""
    exposedField MFString info       [ ]
    exposedField SFString version    "1.1"
    exposedField MFNode joints     [ ]
    exposedField MFNode segments   [ ]
    exposedField MFNode sites      [ ]
    exposedField MFNode viewpoints [ ]
    exposedField MFNode humanoidBody [ ]
]
```

```

exposedField    SFVec3f    center                0 0 0
exposedField    SFRotation rotation             0 0 1 0
exposedField    SFVec3f    scale                 1 1 1
exposedField    SFRotation scaleOrientation     0 0 1 0
exposedField    SFVec3f    translation          0 0 0
]

```

The Humanoid node is typically implemented as follows:

```

{
  Transform {
    center           IS center
    rotation         IS rotation
    scale            IS scale
    scaleOrientation IS scaleOrientation
    translation      IS translation
    children [
      Group {
        children IS viewpoints
      }
      Group {
        children IS humanoidBody
      }
    ]
  }
}

```

The Humanoid node can be used to position the humanoid in space. Note that the HumanoidRoot Joint is typically used to handle animations within the local coordinate system of the humanoid, such as jumping or walking. For example, while walking, the overall movement of the body (such as a swagger) would affect the HumanoidRoot Joint, while the average linear velocity through the scene would affect the Humanoid node.

The humanoidBody field contains the HumanoidRoot node. The version field stores the version of this specification that the Humanoid file conforms to. Value of '1.1' is expected.

The info field consists of an array of strings, each of which is of the form "tag=value". The following tags are defined:

```

authorName
authorEmail
copyright
creationDate
usageRestrictions
humanoidVersion
age
gender (typically "male" or "female")
height
weight

```

Additional tag=value pairs can be included as needed.

The HumanoidVersion tag refers to the version of the humanoid being used, in order to track revisions to the data. It is not the same as the version field of the Humanoid node, which refers to the version of the H-Anim specification which was used when building the humanoid.

The joints field contains references (i.e. USEs) of each of the Joint nodes in the body. Each of the referenced joints should be a Joint node. The order in which they are listed is irrelevant, since the names of the joints are stored in the joints themselves. Similarly, the segments field contains references to each of the Segment nodes of the body, the viewpoints field contains references to the Viewpoint nodes in the file, and the sites field contains references to the Site nodes in the file.

M.4.3 Modeling the Humanoid

Humanoid should be modeled in a standing position, facing in the +Z direction with +Y up and +X to the humanoid's left. The origin (0, 0, 0) should be located at ground level, between the humanoid's feet.

The feet should be flat on the ground, spaced apart about the same distance as the width of the hips. The bottom of the feet should be at Y=0. The arms should be straight and parallel to the sides of the body with the palms of the hands facing inwards towards the thighs. The hands should be flat, with the axes of joints "1" through "3" of the fingers being parallel to the Y axis and the axis of the thumb being angled up at 45 degrees towards the +Z direction. Note that the coordinate system for each joint in the thumb is still oriented to align with that of the overall humanoid.

Movement of the "0" joints of the fingers is typically quite limited, and the rigidity of those articulations varies from finger to finger. Further details about the placement, orientation and movement of the "0" joints can be obtained from any anatomy reference text.

The humanoid should be built with actual human size ranges in mind. All dimensions are in meters. A typical human is roughly 1.75 meters tall.

The default position of the humanoid is defined in ISO/IEC 14496-2:1999.

In this position, all the joint angles should be zero. In other words, all the rotation fields in all the Joint nodes should be left at their default value of (0 0 1 0). In addition, the translation fields should be left at their default value of (0 0 0) and the scale factors should be left at their default value of (1 1 1). The only field which should have a non-default value is center, which is used to specify the point around which the joint (and its attached children and body segment if any) will rotate. Sending the default values for translation, rotation and scaling to all the Joints in the body must return the body to the neutral position described above. The center field of each joint should be placed so that the joints rotate in the same way that they would on a real human body.

It is suggested, but not required, that all of the body segments should be built in place. That is, they should require no translation, rotation, or scaling to be connected with their neighbors. For example, the hand should be built so that it's in the correct position in relation to the forearm. The forearm should be built so that it's in the correct position in relation to the upper arm, and so on. All the body's coordinates will share a common origin, which is that of the humanoid itself. If this proves difficult for an authoring tool to implement, it is acceptable to use a Transform node inside each Segment, or even several **Transforms**, in order to position the geometry for that segment correctly.

Note that the coordinate system for each Joint is oriented to align with that of the overall humanoid.

M.4.3.1 The Joint Hierarchy

The body is typically built as a series of nested Joints, each of which may have a Segment associated with it. For example:

```
...
DEF hanim_1_shoulder Joint { name "1_shoulder"
  center 0.167 1.36 -0.0518
  children [
    DEF hanim_1_elbow Joint { name "1_elbow"
      center 0.196 1.07 -0.0518
      children [
        DEF hanim_1_wrist Joint { name "1_wrist"
          center 0.213 0.811 -0.0338
          children [
            DEF hanim_1_hand Segment { name "1_hand"
              ...
            }
          ]
        }
      ]
    }
    DEF hanim_1_forearm Segment { name "1_forearm"
      ...
    }
  ]
}
DEF hanim_1_upperArm Segment { name "1_upperArm"
  ...
}
}
```

M.4.3.2 The Body

The names of the Joint nodes for the body are listed in the following list:

```

l_hip, l_knee, l_ankle, l_subtalar, l_midiatarsal, l_metatarsal
r_hip, r_knee, r_ankle, r_subtalar, r_midiatarsal, r_metatarsal
vl5, vl4, vl3, vl2, vl1,
vt12, vt11, vt10, vt9, vt8, vt7, vt6, vt5, vt4, vt3, vt2, vt1
vc7, vc6, vc5, vc4, vc3, vc2, vc1
l_sternoclavicular, l_acromioclavicular, l_shoulder, l_elbow, l_wrist
r_sternoclavicular, r_acromioclavicular, r_shoulder, r_elbow, r_wrist
HumanoidRoot, sacroiliac (pelvis), skullbase

```

The vl5 and sacroiliac Joints are children of the HumanoidRoot. The HumanoidRoot is stored in the humanoidBody field of the Humanoid node, but all other Joints are descended from either vl5 or sacroiliac. If those Joints are missing, lower-level Joints can be children of the HumanoidRoot.

M.4.3.3 The Hands

The hands Joint nodes, if present, should use the following naming convention:

```

l_pinky0, l_pinky1, l_pinky2, l_pinky3,
l_ring0, l_ring1, l_ring2, l_ring3
l_middle0, l_middle1, l_middle2, l_middle3
l_index0, l_index1, l_index2, l_index3
l_thumb1, l_thumb2, l_thumb3
r_pinky0, r_pinky1, r_pinky2, r_pinky3
r_ring0, r_ring1, r_ring2, r_ring3
r_middle0, r_middle1, r_middle2, r_middle3
r_index0, r_index1, r_index2, r_index3
r_thumb1, r_thumb2, r_thumb3

```

M.4.3.4 Hierarchy

The complete hierarchy is as follows, with the segment names listed beside the Joints to which they're attached:

```

HumanoidRoot : sacrum
sacroiliac : pelvis
|   l_hip : l_thigh
|   |   l_knee : l_calf
|   |   |   l_ankle : l_hindfoot
|   |   |   |   l_subtalar : l_midproximal
|   |   |   |   |   l_midiatarsal : l_middistal
|   |   |   |   |   |   l_metatarsal : l_forefoot
|   r_hip : r_thigh
|   |   r_knee : r_calf
|   |   |   r_ankle : r_hindfoot
|   |   |   |   r_subtalar : r_midproximal
|   |   |   |   |   r_midiatarsal : r_middistal
|   |   |   |   |   |   r_metatarsal : r_forefoot
v15   : 15
v14   : 14
v13   : 13
v12   : 12
v11   : 11
vt12  : t12
vt11  : t11
vt10  : t10
vt9   : t9
vt8   : t8
vt7   : t7
vt6   : t6
vt5   : t5
vt4   : t4
vt3   : t3
vt2   : t2
vt1   : t1
vc7   : c7
|   vc6 : c6
|   |   vc5 : c5
|   |   |   vc4 : c4

```

```

vc3 : c3
  vc2 : c2
    vc1 : c1
      skullbase : skull
        l_eyelid_joint : l_eyelid
        r_eyelid_joint : r_eyelid
        l_eyeball_joint : l_eyeball
        r_eyeball_joint : r_eyeball
        l_eyebrow_joint : l_eyebrow
        r_eyebrow_joint : r_eyebrow
        temporomandibular : jaw
l_sternoclavicular : l_clavicle
l_acromioclavicular : l_scapula
  l_shoulder : l_upperarm
  l_elbow : l_forearm
  l_wrist : l_hand
    l_thumb1 : l_thumb_metacarpal
    l_thumb2 : l_thumb_proximal
    l_thumb3 : l_thumb_distal
  l_index0 : l_index_metacarpal
  l_index1 : l_index_proximal
  l_index2 : l_index_middle
  l_index3 : l_index_distal
  l_middle0 : l_middle_metacarpal
  l_middle1 : l_middle_proximal
  l_middle2 : l_middle_middle
  l_middle3 : l_middle_distal
  l_ring0 : l_ring_metacarpal
  l_ring1 : l_ring_proximal
  l_ring2 : l_ring_middle
  l_ring3 : l_ring_distal
  l_pinky0 : l_pinky_metacarpal
  l_pinky1 : l_pinky_proximal
  l_pinky2 : l_pinky_middle
  l_pinky3 : l_pinky_distal
r_sternoclavicular : r_clavicle
r_acromioclavicular : r_scapula
  r_shoulder : r_upperarm
  r_elbow : r_forearm
  r_wrist : r_hand
    r_thumb1 : r_thumb_metacarpal
    r_thumb2 : r_thumb_proximal
    r_thumb3 : r_thumb_distal
  r_index0 : r_index_metacarpal
  r_index1 : r_index_proximal
  r_index2 : r_index_middle
  r_index3 : r_index_distal
  r_middle0 : r_middle_metacarpal
  r_middle1 : r_middle_proximal
  r_middle2 : r_middle_middle
  r_middle3 : r_middle_distal
  r_ring0 : r_ring_metacarpal
  r_ring1 : r_ring_proximal
  r_ring2 : r_ring_middle
  r_ring3 : r_ring_distal
  r_pinky0 : r_pinky_metacarpal
  r_pinky1 : r_pinky_proximal
  r_pinky2 : r_pinky_middle
  r_pinky3 : r_pinky_distal

```

Depending on your fonts, the number '1' and the letter 'l' may look similar. This is particularly true for the lumbar vertebrae and their corresponding joints (e.g. v15 and l5). The letter 'l' is for Lumbar, the letter 't' is for Thorasic, and the letter 'c' is for Cervical.

The term "proximal" means "the nearer" segment, and "distal" means "the farther" segment.

Both the sacroiliac and the v15 vertebrae are top-level Joints, and are stored in the bodyDefinition field of the Humanoid node.

The l_sternoclavicular and r_sternoclavicular Joints are children of vt1, and siblings of vc7.

The skullbase Joint is technically the "atlanto-occipital" Joint.

The left and right metatarsals are technically the left and right "tarsometatarsal" joints.

A Joint node may contain 1-3 BAPs. The following table presents the joints, and associated BAPs and segment names.

Table 65 - BAPs in the Joint node

| JOINT NODE | ASSOCIATED BAPs | ATTACHED SEGMENT |
|---------------------|---|---------------------|
| sacroiliac | sacroiliac_tilt, sacroiliac_torsion, sacroiliac_roll | Pelvis |
| l_hip | l_hip_flexion, l_hip_abduct, l_hip_twisting | l_thigh |
| r_hip | r_hip_flexion, r_hip_abduct, r_hip_twisting | r_thigh |
| l_knee | l_knee_flexion, l_knee_twisting | l_calf |
| r_knee | r_knee_flexion, r_knee_twisting | r_calf |
| l_ankle | l_ankle_flexion, l_ankle_twisting | l Hindfoot |
| r_ankle | r_ankle_flexion, r_ankle_twisting | r Hindfoot |
| l_subtalar | l_subtalar_flexion | l_midproximal |
| r_subtalar | r_subtalar_flexion | r_midproximal |
| l_midiatarsal | l_midiatarsal_flexion | l_middistal |
| r_midiatarsal | r_midiatarsal_flexion | r_middistal |
| l_metatarsal | l_metatarsal_flexion | l_forefoot |
| r_metatarsal | r_metatarsal_flexion | r_forefoot |
| vl5 | vl5roll, vl5torsion, vl5tilt | 15 |
| vl4 | vl4roll, vl4torsion, vl4tilt | 14 |
| vl3 | vl3roll, vl3torsion, vl3tilt | 13 |
| vl2 | vl2roll, vl2torsion, vl2tilt | 12 |
| vl1 | vl1roll, vl1torsion, vl1tilt | 11 |
| vt12 | vt12roll, vt12torsion, vt12tilt | t12 |
| vt11 | vt11roll, vt11torsion, vt11tilt | t11 |
| vt10 | vt10roll, vt10torsion, vt10tilt | t10 |
| vt9 | vt9roll, vt9torsion, vt9tilt | t9 |
| vt8 | vt8roll, vt8torsion, vt8tilt | t8 |
| vt7 | vt7roll, vt7torsion, vt7tilt | t7 |
| vt6 | vt6roll, vt6torsion, vt6tilt | t6 |
| vt5 | vt5roll, vt5torsion, vt5tilt | t5 |
| vt4 | vt4roll, vt4torsion, vt4tilt | t4 |
| vt3 | vt3roll, vt3torsion, vt3tilt | t3 |
| vt2 | vt2roll, vt2torsion, vt2tilt | t2 |
| vt1 | vt1roll, vt1torsion, vt1tilt | t1 |
| vc7 | vc7roll, vc7torsion, vc7tilt | c7 |
| vc6 | vc6roll, vc6torsion, vc6tilt | c6 |
| vc5 | vc5roll, vc5torsion, vc5tilt | c5 |
| vc4 | vc4roll, vc4torsion, vc4tilt | c4 |
| vc3 | vc3roll, vc3torsion, vc3tilt | c3 |
| vc2 | vc2roll, vc2torsion, vc2tilt | c2 |
| vc1 | vc1roll, vc1torsion, vc1tilt | c1 |
| Skullbase | skullbase_roll, skullbase_torsion, skullbase_tilt | skull |
| l_sternoclavicular | l_sternoclavicular_abduct, l_sternoclavicular_rotate | l_clavicle |
| l_acromioclavicular | l_acromioclavicular_abduct, l_acromioclavicular_rotate | l_scapula |
| l_shoulder | l_shoulder_flexion, l_shoulder_abduct, l_shoulder_twisting | l_upperarm |
| l_elbow | l_elbow_flexion, l_elbow_twisting | l_forearm |
| r_sternoclavicular | r_sternoclavicular_abduct, r_sternoclavicular_rotate | r_clavicle |
| r_acromioclavicular | r_acromioclavicular_abduct, r_acromioclavicular_rotate | r_scapula |
| r_shoulder | r_shoulder_flexion, r_shoulder_abduct, r_shoulder_twisting | r_upperarm |
| r_elbow | r_elbow_flexion, r_elbow_twisting | r_forearm |
| r_wrist | r_wrist_flexion, r_wrist_pivot, r_wrist_twisting | r_wrist |
| r_thumb1 | r_thumb1_flexion, r_thumb1_pivot, r_thumb1_twisting | r_thumb_metacarpal |
| r_thumb2 | r_thumb2_flexion | r_thumb_proximal |
| r_thumb3 | r_thumb3_flexion | r_thumb_distal |
| r_index0 | r_index0_flexion | r_index_metacarpal |
| r_index1 | r_index1_flexion, r_index1_pivot, r_index1_twisting | r_index_proximal |
| r_index2 | r_index2_flexion | r_index_middle |
| r_index3 | r_index3_flexion | r_index_distal |
| r_middle0 | r_middle0_flexion | r_middle_metacarpal |
| r_middle1 | r_middle1_flexion, r_middle1_pivot, r_middle1_twisting | r_middle_proximal |
| r_middle2 | r_middle2_flexion | r_middle_middle |
| r_middle3 | r_middle3_flexion | r_middle_distal |
| r_ring0 | r_ring0_flexion | r_ring_metacarpal |
| r_ring1 | r_ring1_flexion, r_ring1_pivot, r_ring1_twisting | r_ring_proximal |
| r_ring2 | r_ring2_flexion | r_ring_middle |
| r_ring3 | r_ring3_flexion | r_ring_distal |

| | | |
|-----------|--|---------------------|
| r_pinky0 | r_pinky0_flexion | r_pinky_metacarpal |
| r_pinky1 | r_pinky1_flexion, r_pinky1_pivot, r_pinky1_twisting | r_pinky_proximal |
| r_pinky2 | r_pinky2_flexion | r_pinky_middle |
| r_pinky3 | r_pinky3_flexion | r_pinky_distal |
| l_wrist | l_wrist_flexion, l_wrist_pivot, l_wrist_twisting | l_wrist |
| l_thumb1 | l_thumb1_flexion, l_thumb1_pivot, l_thumb1_twisting | l_thumb_metacarpal |
| l_thumb2 | l_thumb2_flexion | l_thumb_proximal |
| l_thumb3 | l_thumb3_flexion | l_thumb_distal |
| l_index0 | l_index0_flexion | l_index_metacarpal |
| l_index1 | l_index1_flexion, l_index1_pivot, l_index1_twisting | l_index_proximal |
| l_index2 | l_index2_flexion | l_index_middle |
| l_index3 | l_index3_flexion | l_index_distal |
| l_middle0 | l_middle0_flexion | l_middle_metacarpal |
| l_middle1 | l_middle1_flexion, l_middle1_pivot, l_middle1_twisting | l_middle_proximal |
| l_middle2 | l_middle2_flexion | l_middle_middle |
| l_middle3 | l_middle3_flexion | l_middle_distal |
| l_ring0 | l_ring0_flexion | l_ring_metacarpal |
| l_ring1 | l_ring1_flexion, l_ring1_pivot, l_ring1_twisting | l_ring_proximal |
| l_ring2 | l_ring2_flexion | l_ring_middle |
| l_ring3 | l_ring3_flexion | l_ring_distal |
| l_pinky0 | l_pinky0_flexion | l_pinky_metacarpal |
| l_pinky1 | l_pinky1_abduct, l_pinky1_flexion | l_pinky_proximal |
| l_pinky2 | l_pinky2_flexion | l_pinky_middle |
| l_pinky3 | l_pinky3_flexion | l_pinky_distal |

Note that the body can be defined by a subset of **Joint** nodes.

Many **Joints** may be omitted, such as most of the vertebrae, the midtarsal, and the acromioclavicular. The spinal **Joints** that belong to first spine groups are the ones that should be given priority if a full spine is not implemented.

Note that VRML H-Anim syntax permits having multiple humanoids in the same file. However, for the files used for BDPs, it is required that the **BodySceneGraph** node contains only one humanoid.

M.4.3.5 Other Nodes

Other nodes, such as non-standard joints, viewpoint nodes, displacement nodes, can be defined. These nodes are ignored for the purposes of body animation from FBA elementary stream, but could be updated using BIFS stream.

Annex N (Informative)

Implementation of MaterialKey node

An example implementation is presented below to reveal the intended use of the color key information. To calculate the transparency (alpha) value for each pixel, first the distance d between the unnormalized key color (C_1, C_2, C_3) and the color (X_1, X_2, X_3) of the pixel of interest is calculated.

If the magnitude of the variance of the pixel falls between the 2 thresholds, the alpha value for that pixel will be scaled between completely transparent, and the transparency value given for the opaque region. The following describes how the alpha value for a given pixel is determined.

c_1 – The normalized value of the R (or Y) component of the keycolor (in range 0.0 to 1.0)

c_2 – The normalized value of the G (or U) component of the keycolor (in range 0.0 to 1.0)

c_3 – The normalized value of the B (or V) component of the keycolor (in range 0.0 to 1.0)

The respective unnormalized values of c_1, c_2, c_3 are C_1, C_2, C_3 and are obtained by multiplying c_1, c_2, c_3 by $k = 2^n - 1$, which for n=8 bit video is 255; this computation is performed only once at the time of selection of a new keycolor and the results are stored. Also, by scaling k , a factor $K=3 \times k$ can be precomputed and stored; this needs to be done just once.

X_1 – The value of the R (or Y) component (in the range 0 to k) of the pixel for which the alpha value is to be computed

X_2 – The value of the G (or U) component (in the range 0 to k) of the pixel for which the alpha value is to be computed

X_3 – The value of the B (or V) component (in the range 0 to k) of the pixel for which the alpha value is to be computed

T – Transparency value assigned to the opaque region (in range 0.0 to 1.0)

d_1 – Low threshold for transparency detection (in range 0.0 to T)

d_2 – High threshold for transparency detection (in range 0.0 to T)

$$d = (|C_1 - X_1| + |C_2 - X_2| + |C_3 - X_3|) * T / K$$

The resulting normalized value of distortion d lies in the range of 0.0 to T .

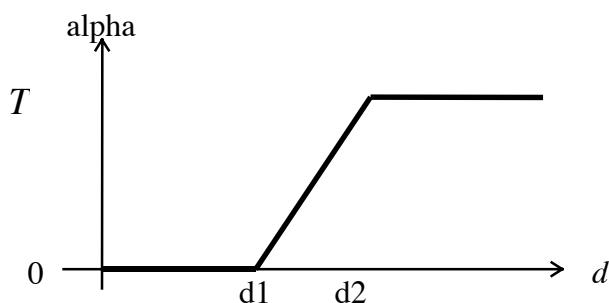


Figure 39 - Alpha value as a function of distance measure

The reconstructed alpha value for each pixel is computed by comparing the distance d with the thresholds as follows:

```
if (d ≤ d1) then alpha = 0,  
else if (d > d2) then alpha = T,  
else if (d1 < d ≤ d2) then alpha = (d-d1)/(d2-d1) * T
```

Here, $\alpha = 0$ is transparent and $\alpha = T$ is the transparency value assigned to the opaque region.

Further, $d_1 = d_2$ implies binary shape, otherwise grey scale shape is obtained.

Annex O (Informative)

Example implementation of spatial audio processing (perceptual approach)

O.1 Example algorithm implementation

This section describes a rendering algorithm which can be controlled by the proposed perceptual parameters. It receives as inputs an audio source url, the nine perceptual parameters, the position of the source with respect to the view point, the directivity diagram of the source, and the **directFilter** and **inputFilter** parameters. It produces seven channels, one for the direct sound C, two for the early reflections L and R, and four for the diffuse field S1, S2, S3 and S4. Ideally these are to be played back according to the diagram shown below. The four main parts of the *Room* module are detailed below in the case of an 8-channel implementation of the complete model (including the *early* and *cluster* blocks).

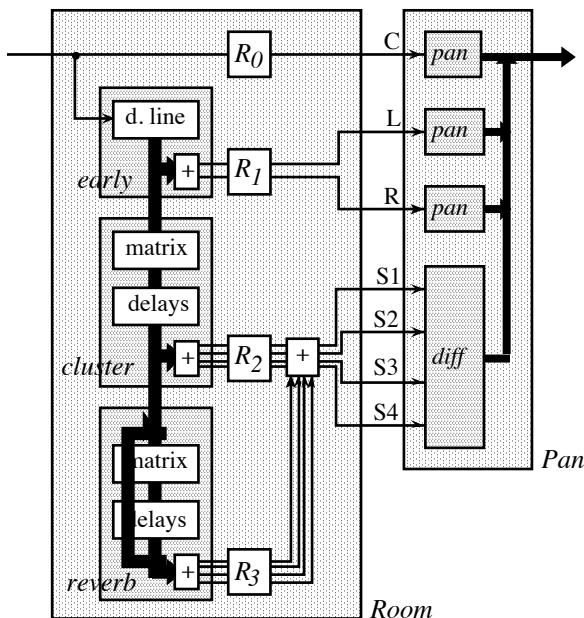


Figure 40 - Association of *Room* and *Pan* modules forming a *Spat* processor.

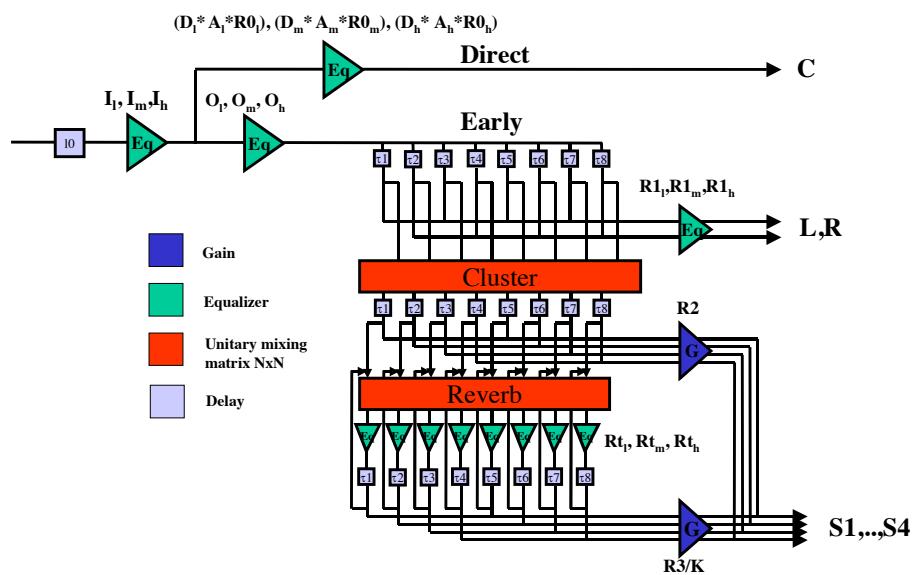


Figure 41 - Block diagram of the *Room* module

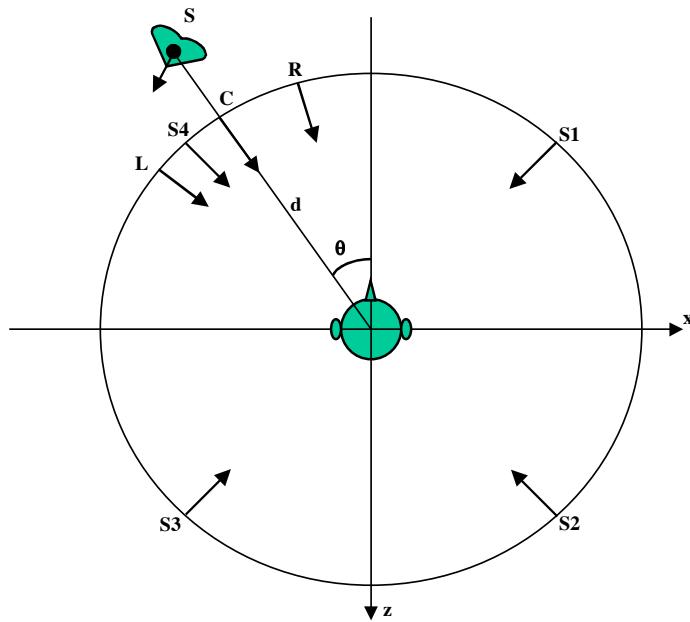


Figure 42 - Directional rendering by the Pan module

O.2 Elementary spectral corrector

An elementary component used in multiple instances in the *Room* module is the second order IIR filter whose equation is given by :

$$y(n) = b_0 x(n) + b_1 x(n-1) + b_2 x(n-2) - a_1 y(n-1) - a_2 y(n-2).$$

This filter is used as a 3-band parametric equalizer, the characteristics of which are given by:

- f_{low} : higher crossover frequency expressed in Hz
- f_{high} : lower crossover frequency expressed in Hz
- g_{low} : filter gain in the low band expressed w.r.t amplitude
- g_{mid} : filter gain in the mid band expressed w.r.t amplitude
- g_{high} : filter gain in the high band expressed w.r.t amplitude

The method to calculate the 2nd order cell coefficients is given by :

a)

$$f'_{\text{low}} = f_{\text{low}}/f_s$$

$$f'_{\text{high}} = f_{\text{high}}/f_s$$

where f_s is the sampling rate

b)

$$g'_{\text{low}} = g_{\text{low}}/g$$

$$g'_{\text{mid}} = g_{\text{mid}}/g$$

$$g'_{\text{high}} = g_{\text{high}}/g$$

where g is a gain factor that prevent the filter coefficients from being inaccurate for very low values of g_{low} , g_{mid} and g_{high} and so degrading the filtering process. Generally, gain is taken to be equal to g_{mid} .

c)

$$k_1 = g_{\text{low}}^r / g_{\text{mid}}^r$$

$$r_1 = \tan(\pi * f_{\text{low}}^r) / k_1^{0.5}$$

$$\alpha_1 = (r_1 - 1) / (r_1 + 1)$$

$$\beta_1 = (k_1 * r_1 - 1) / (k_1 * r_1 + 1)$$

$$\chi_1 = (k_1 * r_1 - 1) / (r_1 + 1)$$

d)

$$k_2 = g_{\text{mid}}^r / g_{\text{high}}^r$$

$$r_2 = \tan(\pi * f_{\text{high}}^r) / k_2^{0.5}$$

$$\alpha_2 = (r_2 - 1) / (r_2 + 1)$$

$$\beta_2 = (k_2 * r_2 - 1) / (k_2 * r_2 + 1)$$

$$\chi_2 = (k_2 * r_2 - 1) / (r_2 + 1)$$

e)

$$k = g_{\text{mid}}^r * g$$

$$b_o = \chi_1 * \chi_2 * k$$

$$b_1 = (\beta_1 + \beta_2) * b_o$$

$$b_2 = (\beta_1 * \beta_2) * b_o$$

$$a_1 = \alpha_1 + \alpha_2$$

$$a_2 = \alpha_1 * \alpha_2$$

O.3 Input Filter

In order to simulate sound sources that are outside the virtual room, a pre-filtering process can be performed with the values given in the **inputFilter** field, I_{low} , I_{mid} , I_{high} , via a three-band equalization.

O.4 Direct path

The signal which stands for the direct path (without any reflection) is calculated via a 3-band equalizer from the input signal S . The coefficients of this equalizer are calculated according to the avant-propos with the following energetic parameters $A_{\text{low}} * D_{\text{low}} * R0_{\text{low}}$, $A_{\text{mid}} * D_{\text{mid}} * R0_{\text{mid}}$, $A_{\text{high}} * D_{\text{high}} * R0_{\text{high}}$, f_{min} and f_{max} , where the A 's, D 's and $R0$'s represents respectively the axis directivity, the direct filter coefficients and the energetic repartition of the source in the three bands $[0, f_{\text{min}}]$, $[f_{\text{min}}, f_{\text{max}}]$ and $[f_{\text{max}}, f_s/2]$

f_{min} and f_{max} are given in the **PerceptualParameters** node fields.

O.5 Directional early reflections

The source signal S is first filtered in an equalizer which depends only on the diffuse-field frequency response of the source, i.e. the omnidirectionality of the source. Its parameters are $O_{\text{low}}, O_{\text{mid}}, O_{\text{high}}, f_{\text{min}}$ and f_{max} where the O's give the diffuse-field amplitude of the source in the three bands $[0, f_{\text{min}}]$, $[f_{\text{min}}, f_{\text{max}}]$ and $[f_{\text{max}}, f_s/2]$

The output of this equalizer feeds a delay line that produces eight channels, $\text{early}[i]$, $i=0..7$, which are time shifted.

The eight delay lengths are randomly distributed between approximately 20 and 40 ms for a large room, but could be set differently in order to simulate a smaller room. The exact values to be used are given in 1.2.6.6.6.

The early signals are multiplied by gains, g_i , and combined to produce two signals, Lo and Ro as follows :

$$\text{Lo} = \text{early}[0]*g_0 + \text{early}[2]*g_2 + \text{early}[4]*g_4 + \text{early}[6]*g_6$$

$$\text{Ro} = \text{early}[1]*g_1 + \text{early}[3]*g_3 + \text{early}[5]*g_5 + \text{early}[7]*g_7$$

Note - In the proposed implementation $g_i = 1.0$, $i=0..7$

Lo and Ro are then filtered with two equalizers having the following parameters $R1_{\text{low}}, R1_{\text{mid}}, R1_{\text{high}}, f_{\text{min}}$ and f_{max} , in order to produce L and R that represent the early reflections.

Diffuse early reflections

The eight outputs of the *Early* delay line are mixed in a unitary Hadamard (8x8) matrix to produce eight scrambled signals :

$$[\text{Cscramb}_i]_{i=0..7} = H_{8x8}[\text{early}_i]_{i=0..7}$$

The scrambled signals are independently delayed :

$$\text{Cscramb}^d[i](t) = \text{Cscramb}[i](t-\tau_i), i=0..7$$

The values of the τ_i are randomly distributed between 20 and 60 ms approximately (default setting for a large room). The exact values to be used are given in 1.2.6.6.6.

The $\text{Cscramb}^d[i]$ are combined to produce four intermediate signals that will feed the cluster equalizers R2 :

$$\text{Ctemp}_1 = \text{Cscramb}^d[0] + \text{Cscramb}^d[4]$$

$$\text{Ctemp}_2 = \text{Cscramb}^d[1] + \text{Cscramb}^d[5]$$

$$\text{Ctemp}_3 = \text{Cscramb}^d[2] + \text{Cscramb}^d[6]$$

$$\text{Ctemp}_4 = \text{Cscramb}^d[3] + \text{Cscramb}^d[7]$$

The four signals $\text{Ctemp}_{i=0..3}$ are then filtered with four equalizers that have the following parameters $R2_{\text{low}}, R2_{\text{mid}}, R2_{\text{high}}, f_{\text{min}}$ and f_{max} , in order to produce the diffuse field signals corresponding to the cluster part of the impulse response: $\text{R2}_0, \text{R2}_1, \text{R2}_2$ and R2_3

O.6 Diffuse late reverberation

This stage is quite similar to the previous one except that in order to reproduce the late reverberation decay, a feedback delay network (FDN) is used.

The eight input signals are mixed in a unitary Hadamard (8x8) matrix producing eight scrambled signals :

$$[\text{Rscramb}_i]_{i=0..7} = H_{8x8}[\text{Cscramb}^d_i + \text{Rscramb}^d_i]_{i=0..7}$$

The scrambled signals are independently delayed:

$$\text{Rscramb}^d[i](t) = \text{Rscramb}[i](t-\tau_i), i=0..7$$

The values of the τ_i are randomly distributed between 60 and 140 ms approximately (for a large room). The exact values to be used are given in 1.2.6.6.6.

Then these signals are filtered with 8 equalizers that have the following parameters :

$p_{lowi}, p_{mid}, p_{highi}, f_{min}, f_{max}$

where

$$p_{lowi} = 10^{(-60 * \tau_i / R_{low})}$$

$$p_{mid} = 10^{(-60 * \tau_i / R_{mid})}$$

$$p_{highi} = 10^{(-60 * \tau_i / R_{high})}$$

to produce the $Rscramb^{eq}[i]$ signals

The $Rscramb^{eq}[i]$ are combined to produce four intermediate signals :

$$Rtemp_1 = Rscramb^{eq}[0] + Rscramb^{eq}[4]$$

$$Rtemp_2 = Rscramb^{eq}[1] + Rscramb^{eq}[5]$$

$$Rtemp_3 = Rscramb^{eq}[2] + Rscramb^{eq}[6]$$

$$Rtemp_4 = Rscramb^{eq}[3] + Rscramb^{eq}[7]$$

The four signals $Rtemp_{i=0, \dots, 3}$ are then scaled by a gain $R3$.

The complete diffuse field is simply calculated from the cluster and the late reverberation fields signals as follows :

$$S1 = R2_0 + R3_0$$

$$S2 = R2_1 + R3_1$$

$$S3 = R2_2 + R3_2$$

$$S4 = R2_3 + R3_3$$

O.7 Setting the delays

In the Perceptual node field, four values related to the temporal characteristics of the impulse response are given: the time limits l_1, l_2, l_3 and the modal density.

The Room structure has three sets of delays, respectively for the *Early*, *Cluster* and *Reverb* modules.

The delay ranges to be used can be calculated as follows :

Table 66 - delay ranges

| | min | max |
|----------------|-----------------|-----------------|
| early delays | l_1 | l_2 |
| cluster delays | $l_2 - l_1$ | $l_3 - l_2 + e$ |
| reverb delays | $l_3 - l_2 - e$ | (*) |

e can be used to create some overlapping between the temporal sections R_2 and R_3 if necessary.

(*): in the *Reverb* module, the distribution of delay lengths is not constrained by their maximum, but by their sum, which is equal to the value *modal density* (expressed indifferently in seconds or modes per hertz).

O.8 Scalability

The above modular signal processing model provides several forms of scalability:

- modifying the number of discrete reflections in the *early* block
- modifying the number of delay channels in the *cluster* and *reverb* blocks (typically 4, 6 or 8 channels)
- suppressing the *cluster* block, and possibly the *early* block
- sharing the *reverb* block and possibly the *cluster* block between several sources (located in the same room)
- replacing the equalizers by simple gains. In that case the frequency effects will not be rendered, e.g room liveness and source warmth.

Annex P (informative)

Upstream walkthrough

P.1 Introduction

Upstream messages from a client terminal to the server terminal are categorized in two types, application specific command messages and media stream specific messages. Application specific command messages are general messages applied to a set of different media streams, for example, stream control messages. These messages may be defined based on the BIFS ServerCommand node. Media stream specific messages are used to establish communication between a specific media stream decoder and its encoder. This may be used, for example, to control the encoder remotely from the client terminal side as a result of the decoding process or user interaction. The syntax and semantics of media stream specific messages are defined in the relevant part of the standard. For example, the syntax and semantics of messages for the visual NEWPRED tool are defined in IS 14496-2, defining the Visual tools of this specification.

The need for an upstream channel is signaled to the client terminal by supplying an appropriate elementary stream descriptor declaring the parameters for that stream. The client terminal opens this upstream channel in a similar manner as it opens the downstream channels. The entities (e.g. media encoders & decoders) that are connected through an upstream channel are known from the parameters in its elementary stream descriptor and from the association of the elementary stream descriptor to a specific object descriptor.

Packetization of upstream messages for transmission and synchronization with downstream channel data is done by the synchronization layer. The configuration of the SL packet header for upstreams may be selected as appropriate. All messages that are related to a single point in time should be packetized into a single access unit.

P.2 Configuration

An upstream can be associated to a single downstream or a group of downstreams. The scope of the upstream is defined by the stream type of the downstream to which the upstream is associated. When the upstream is associated to a single downstream it carries messages about the downstream it is associated to. If the upstream should carry messages related to a group of downstreams, its elementary stream descriptor is associated to the ObjectDescriptorStream containing object descriptors or the SceneDescriptionStream describing the scene, as specified in 8.7.1.5.2.

In the case that the upstream is attached to the ObjectDescriptorStream, only the object descriptors grouped together for this single upstream would be carried by it. The other object descriptors outside the scope of this upstream would be carried by other ObjectDescriptorStreams. This implies that the object descriptors requiring a single upstream should be carried separately from the other object descriptors. If the upstream depends on a SceneDescriptionStream, all the objects inside the scene would get the upstream messages from this upstream.

Detailed configuration rules for each case are as described below.

P.2.1 Upstream for single ES

In this case the upstream is attached to a single independent ES and will carry media specific information valid for a single downstream it is dependent on. Because only one of the independent elementary streams defined in the same OD can be selected for use in the scene, the upstream is not related to the ES itself but rather to the object represented by this OD.

The ObjectDescriptor has one or more additional ES_Descriptors defining upstream configuration for each ES which needs a backchannel.

ES_Descriptor of upstream shall be defined as follows

streamDependenceFlag shall be set to '1' to indicate this stream depends on a downstream.

dependsOn_ES_ID shall be set to the ES_ID value of the downstream.

DecoderConfigDescriptor in ES_Descriptor of upstream shall be defined as follows.

objectTypeIndication and streamType shall be set to the same value of the downstream

upStream flag shall be set to '1' to indicate this is a backchannel stream.

bufferSizeDB, maxBitrate, avgBitrate and DecoderSpecificInfo shall be set appropriately.

P.2.2 Upstream for a group of ESs

In this case the upstream is attached to an ObjectDescriptorStream or a SceneDescriptionStream to be used as an upstream for a group of elementary streams. The basic configuration rules for the ObjectDescriptor are the same as in the case of upstream for a single ES. The scope and type of messages carried by the upstream is decided by the following rules.

If an upstream is configured to be dependent on a certain ObjectDescriptorStream and its streamType is either VisualStream or AudioStream, it carries media stream specific information that may relate to more than one of the downstreams that are described by the ObjectDescriptors transmitted within the ObjectDescriptorStream upon which the upstream depends. All decoders for streams with matching streamType within that set of streams may use the upstream channel to send messages.

If an upstream is configured to be dependent on a certain SceneDescriptionStream and its streamType is either VisualStream or AudioStream, it carries media specific information for downstreams in the whole scene as described by the SceneDescriptionStream upon which the upstream depends. All decoders for streams with matching streamType within that set of streams may use the upstream channel to send messages.

If an upstream is configured to be dependent on a certain SceneDescriptionStream and its streamType is SceneDescriptionStream, it will carry messages related to the BIFS scene or to application signaling (e.g. based on the ServerCommand specification).

P.3 Content access procedure with DAI

When the receiving terminal receives a DecoderConfigDescriptor whose upStream flag is set to '1', it opens a logical channel for the upstream ES by setting the 'direction' field of the DA_ChannelAdd primitive to UPSTREAM. Other procedures and rules for accessing and managing content at the client terminal are basically the same as for the case of downstream. The syntax and semantics of upstream messages, defining their functionality and the expected interaction between encoder and decoder, are defined in the appropriate part of ISO/IEC 14496. Messages related to streams of streamType SceneDescriptionStream and ObjectDescriptorStream are defined in this part of the specification. Concerning upstream management at the sending terminal, this standard does not normatively specify any behavioral procedures or rules.

P.4 Example

This section describes an example of the setup and the usage of MPEG-4 upstreams, according to the rules described in the above sections.

P.4.1 Example scene having objects with upstream

Figure P-1 shows a simple scene with 3 objects (1 natural video and 2 SNHC objects) for which information is gathered through different upstreams:

- ServerCommand upstream is used to control the animation (start, stop, ...) of **all** objects (natural video and SNHC) in the scene (possibly also audio objects).
- NewPred upstream is used for error correction of a **single natural video** object.
- SNHC_QoS upstream conveys information of the client terminal w.r.t. its decoding and rendering capabilities for **all 3D (SNHC)** objects.

The example scene of Figure P-1 is described through the object descriptor Full_Scene, which points to different streams:

```

InitialObjectDescriptor Full_Scene{
    bit(10) Full_Scene_ID (=OD_ID);
    bit(1) 0 (=URL_Flag);
    bit(1) 1 (=includeInlineProfileLevelFlag);
    const bit(4) reserved=0b1111;
    bit(8) ODProfileLevelIndication;
    bit(8) sceneProfileLevelIndication;
    bit(8) audioProfileLevelIndication;
    bit(8) visualProfileLevelIndication;
    bit(8) graphicsProfileLevelIndication;
    ES_Descriptor SceneDescriptionStream_Scene_1_down;
    ES_Descriptor SceneDescriptionStream_Scene_1_up;
    ES_Descriptor ObjectDescriptorStream_Scene_1_down;
    ES_Descriptor ObjectDescriptorStream_Scene_1_up;
}

```

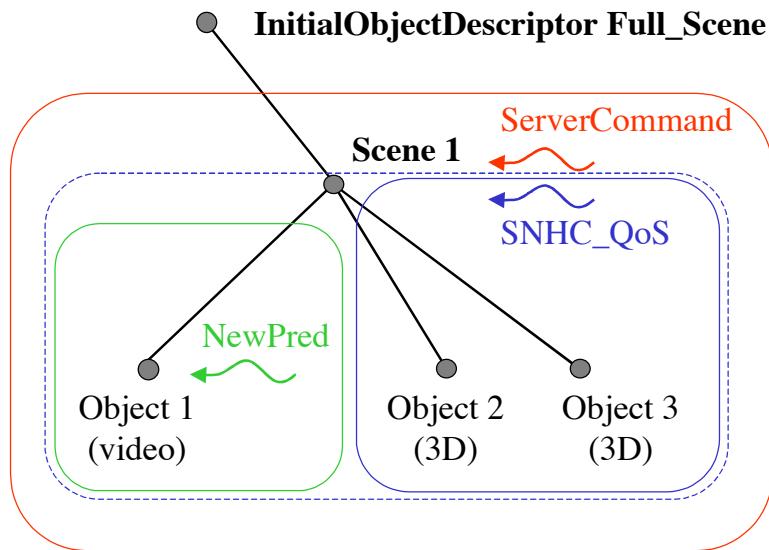


Figure 43 - Backchannel information transport in a simple audio-visual scene

P.4.2 Stream configuration

Graphical summaries of the stream configuration for the example scene shown in Figure 43 are given in Figure 44 to Figure 46. In those figures configuration rules of the important fields and stream dependencies are described in detail.

```

InitialObjectDescriptor Full_Scene{
    ES_Descriptor SceneDescriptionStream_Scene_1_down;
    ES_Descriptor SceneDescriptionStream_Scene_1_up;
    ES_Descriptor ObjectDescriptorStream_Scene_1_down;
    ES_Descriptor ObjectDescriptorStream_Scene_1_up;
}

    ES_Descriptor SceneDescriptionStream_Scene_1_down {
        bit(16) SceneDescriptionStream_Scene_1_down_ID (=ES_ID);
        bit(1) 0 (=streamDependenceFlag);
        DecoderConfigDescriptor dec_config_SceneDescriptionStream_Scene_1_down;
    }

    DecoderConfigDescriptor dec_config_SceneDescriptionStream_Scene_1_down {
        bit(8) 0x01 (=objectTypeIndication); // System ISO/IEC 14496-1
2       bit(6) 0x03 (=streamType);           // SceneDescriptionStream
        bit(1) 0 (=down/upstream);          // Downstream
    }

    ES_Descriptor SceneDescriptionStream_Scene_1_up {
        bit(16) SceneDescriptionStream_Scene_1_up_ID (=ES_ID);
        bit(1) 1 (=streamDependenceFlag);   ↓1
        bit(16) SceneDescriptionStream_Scene_1_down_ID;
        DecoderConfigDescriptor dec_config_SceneDescriptionStream_Scene_1_up;
    }

    DecoderConfigDescriptor dec_config_SceneDescriptionStream_Scene_1_up {
        bit(8) 0x01 (=objectTypeIndication); // System ISO/IEC 14496-1
        bit(6) 0x03 (=streamType);           → 4 // SceneDescriptionStream → 4
            3                                // => conveys ServerCommand
        bit(1) 1 (=down/upstream);          // Upstream
    }
}

```

Figure 44 - Syntax for SceneDescription streams

```

InitialObjectDescriptor Full_Scene{
    ES_Descriptor SceneDescriptionStream_Scene_1_down;
    ES_Descriptor SceneDescriptionStream_Scene_1_up;
    ES_Descriptor ObjectDescriptorStream_Scene_1_down;
    ES_Descriptor ObjectDescriptorStream_Scene_1_up;
}

    ES_Descriptor ObjectDescriptorStream_Scene_1_down {
        bit(16) ObjectDescriptorStream_Scene_1_down_ID (=ES_ID);
        bit(1) 0 (=streamDependenceFlag);
        DecoderConfigDescriptor dec_config_ObjectDescriptorStream_Scene_1_down;
    }

    DecoderConfigDescriptor dec_config_ObjectDescriptorStream_Scene_1_down {
        bit(8) 0x01 (=objectTypeIndication); // System ISO/IEC 14496-1
6       bit(6) 0x01 (=streamType);           // ObjectDescriptorStream
        bit(1) 0 (=down/upstream);          // Downstream
    }

    ES_Descriptor ObjectDescriptorStream_Scene_1_up {
        bit(16) ObjectDescriptorStream_Scene_1_up_ID (=ES_ID);
        bit(1) 1 (=streamDependenceFlag);   ↓5
        bit(16) ObjectDescriptorStream_Scene_1_down_ID;
        DecoderConfigDescriptor dec_config_ObjectDescriptorStream_Scene_1_up;
    }

    DecoderConfigDescriptor dec_config_ObjectDescriptorStream_Scene_1_up {
        bit(8) 0x20 (=objectTypeIndication); // Visual ISO/IEC 14496-2
        bit(6) 0x01 (=streamType);           → 7 // ObjectDescriptorStream → 8
            7                                // => conveys SNHC_QoS
        bit(1) 1 (=down/upstream);          // Upstream
    }
}

```

Figure 45 - Syntax for ObjectDescriptor streams

In Figure 44, dependencies and configurations of two SceneDescriptionStreams are shown. Upstream SceneDescriptionStream_Scene_1_up is dependent on downstream SceneDescriptionStream_Scene_1_down (see arrows 1 and 2 in figure). Its streamType is set to SceneDescriptionStream since it will carry ServerCommand messages (see arrows 3 and 4 in figure).

In Figure 45, dependencies and configurations of two ObjectDescriptionStreams are shown. Upstream ObjectDescriptionStream_Scene_1_up is dependent on downstream ObjectDescriptionStream_Scene_1_down (see arrows 5 and 6 in figure). Its streamType is set to VisualStream since it will carry SNHC_QoS messages for object 2 and object 3 in this example (see arrows 7 and 8 in figure). ObjectDescriptorStream_Scene_1_up conveys SNHC_QoS information that is related to all SNHC objects of the underlying group of objects (possibly single object). This SNHC_QoS information is basically attached to all Visual objects (see dashed box in Figure P-1), but the definition of SNHC_QoS constrains the scope of application to SNHC objects only. Whether the Visual objects are of type SNHC or Natural cannot be determined at the system level : it is determined at the Visual syntax level, by the visual_object_type, in accordance to table 6-5 of ISO/IEC14496-2.

```

ObjectDescriptor Object_1 {
    bit(10) Object_1_ID (=OD_ID);
    ES_Descriptor Object_1_down; ——————
    ES_Descriptor Object_1_up; ——————
}

ES_Descriptor Object_1_down{ ←—————
    bit(16) Object_1_down_ID (=ES_ID);
    bit(1) 0 (=streamDependenceFlag);
    DecoderConfigDescriptor dec_config_Object_1_down; ——————
}

DecoderConfigDescriptor dec_config_Object_1_down { ←—————
    bit(8) 0x20 (=objectTypeIndication); // Visual ISO/IEC 14496-2
10     bit(6) 0x04 (=streamType); // Visual stream
    bit(1) 0 (=down/upstream); // Downstream
}

ES_Descriptor Object_1_up{ ←—————
    bit(16) Object_1_up_ID (=ES_ID);
    bit(1) 1 (=streamDependenceFlag); —————— 9
    bit(16) Object_1_down_ID; ←————— 9
    DecoderConfigDescriptor dec_config_Object_1_up; ——————
}

DecoderConfigDescriptor dec_config_Object_1_up { ←—————
    bit(8) 0x20 (=objectTypeIndication); // Visual ISO/IEC 14496-2
    bit(6) 0x04 (=streamType); —————— 11 // Visual stream —————— 12 // => conveys NewPred —————— 12
    bit(1) 1 (=down/upstream); // Upstream
}

```

Figure 46 - Syntax for Object_1 streams

In Figure 46, dependencies and configurations of two Elementary Streams are shown. Upstream Object_1_up is dependent on downstream Object_1_down (see arrows 9 and 10 in figure). Its streamType is set to VisualStream since it will carry NewPred messages for object 1 in this example (see arrows 11 and 12 in figure). Object_1_up conveys NewPred information for the corresponding natural video object. The definition of NewPred automatically constrains its application to single natural video objects, i.e. the behavior of the server-client system is undefined if a NewPred command is associated to a group of objects and/or a single non-natural video object.

Annex Q

(Informative)

Layout of Media Data

The MP4 format provides a great deal of flexibility in how the media data is physically arranged within a file. This flexibility is desirable and useful. However, it allows media layouts to be created that may be inefficient for playback on a given device. It should also be noted, however, that a media layout which is inefficient for a given device may be very efficient for another. Therefore, it is not the intention of this discussion to define a given type of media layout as wrong. Rather, the intention is to define some common uses of MP4 files and describe the media layout in these circumstances.

An MP4 file can reference media data stored in a number of files, including the MP4 file itself. If an MP4 file only references media data contained within itself, the MP4 file is said to be "self-contained".

An MP4 file can reference media data stored in files that are not MP4 files. This is because the MP4 format references media within a URL by file offset, rather than by a data structuring mechanism of a particular file format. This allows an MP4 file to refer to data stored in any container format.

It is often convenient to store a single elementary stream per file, for example when encoding content. It is also useful for content reuse — to reuse an elementary stream, it is not necessary to extract it from a larger, possibly multiplexed file. Because MP4 can reference media stored in any file, it is not required that elementary stream files be stored in the MP4 format. However, this is recommended. Putting the elementary streams in a MP4 file has several advantages, particularly in enabling interchange of the content between different tools (since MP4 is the only normative file format for MPEG-4 media). Further, the MP4 format adds very little overhead to the elementary stream — as little as a few hundred bytes in many cases — so there is no great penalty in storage space. It may be useful to give a name to these types of files — MP4 files that contain a single elementary stream — so that they can be consistently described.

One of the issues facing any device (server, local workstation) that is attempting to play back an MP4 file in real time is the number of file seeks that must be performed. It is possible to arrange the data in an MP4 file to minimize, and potentially eliminate, any seeks during the course of normal playback. (Of course random access and other kinds of interactivity will require seeks). This is accomplished by interleaving the elementary stream data in the MP4 file in such a way that the layout of the media in the file corresponds to the order in which the media data will be required. It is expected that most servers, for example, will stream MPEG-4 media using the facilities of the hint track. Let's take a scenario where the MP4 file contains a single hint track that references an audio and a visual elementary stream. In order to eliminate all seeks, the hint track media must be interleaved with the audio and visual stream data. Furthermore, because the hint track sample must always be read before the audio and/or visual media that it references, the hint track samples must always immediately precede the samples they reference. Here's a simple illustration of the ordering of data (time and file offset increasing from left to right).

H0 A0 H1 V1 H2 V2 H3 A1 H4 A2 V3 H5 V4

Note that when a single hint sample references to multiple pieces of elementary stream data, those pieces of media data must be occur in the order that they are referenced.

Annex R
(Informative)

Random Access

Seeking with a MP4 file is accomplished primarily by using the subatoms contained in the Sample Table atom. If an edit list is present, it must also be consulted. When asked to seek a given track to a time T, where T is in the time scale of the movie header atom, you may perform the following operations:

If the track contains an edit list, determine which edit contains the time T by iterating over the edits. The start time of the edit in the Movie time scale must then be subtracted from the time T to generate T', the duration into the edit in the Movie time scale. T' is next converted to the timescale of the track's media to generate T''. Finally, the time in the media scale to use is calculated by adding the media start time of the edit to T''.

The time-to-sample atom for a track indicates what times are associated with which sample for that track. Use this track to find the first sample prior to the given time.

The sample that was located in step one may not be a random access point. Locating the nearest random access point requires consulting two atoms. The sync sample table indicates which samples are in fact random access points. Using this table, you can locate which is the first sync sample prior to the specified time. The absence of the sync sample table indicates that all samples are synchronization points, and makes this problem easy. The shadow sync atom gives the opportunity for a content author to provide samples that are not delivered in the normal course of delivery, but which can be inserted to provide additional random access points. This improves random access without impacting bitrate during normal delivery. This atom maps samples that are not random access points to alternate samples that are. You should also consult this table if present to find the first shadow sync sample prior to the sample in question. Having consulted the sync sample table and the shadow sync table, you probably wish to seek to whichever resultant sample is closest to, but prior to, the sample found in step 1.

At this point you know the sample that will be used for random access. Use the sample-to-chunk table to determine in which chunk this sample is located.

Knowing which chunk contained the sample in question, use the chunk offset atom to figure out where that chunk begins.

Starting from this offset, you can use the information contained in the sample-to-chunk atom and the sample size atom to figure out where within this chunk the sample in question is located. This is the desired information.

Annex S
(Informative)**Starting the Java Virtual Machine**

The objective of this annex is to describe the issues involved in deciding when a Java Virtual Machine (JVM) is required to be started, in cases where it is started by the terminal. Typically, invoking or starting a Java Virtual Machine can be time consuming.

The JVM needs to be started only when there is an OD with an MPEG-J Elementary Stream. If starting the JVM is delayed till such time, it obviates the need for starting a JVM in an MPEG-J terminal when there is no MPEG-J ES. By changing the time at which the OD corresponding to the MPEG-J ES is received the terminal, the time at which the JVM is started can be controlled. By sending the OD sufficiently ahead it can be ensured that terminals of varying compute resources can still start the JVM by the required time.

It is not necessary to start the MPEG-J session until it is clear that MPEG-J application programs will be received and are to be executed. When an MPEG-J stream is received right in the beginning the JVM is instantiated and the MPEG-J "decoder" is set up along with all the other Elementary Stream decoders that are essential for that MPEG-4 session. The MPEG-4 Player is started only after this is done. This could result in some delay.

If the OD of MPEG-J elementary streams received by the terminal later than the ODs of the other elementary streams, the terminal could start the MPEG-4 session while the MPEG-J decoder will be setup only after the reception of the OD of MPEG-J ES. However, there is no implicit relationship in the time instants between when an MPEG-J ES is received and its corresponding Object Descriptor.

Annex T (Informative)

Examples of MPEG-J API usage

This annex will include code snippets on the usage of the different categories of MPEG-J APIs. The purpose of this annex is, however, not to show typical applications. The scope of this annex is to enable a user to quickly get started on using MPEG-J APIs.

T.1 Scene APIs :

Examples in this subclause show how to use the scene APIs. Given below is an example that shows how an MPEGlet can access, modify, and created nodes in the scene.

```

import org.iso.mpeg.mpegj.resourceManager.*;
import org.iso.mpeg.mpegj.scene.*;
import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.net.*;

public class Scene_Example implements MPEGlet
{
    MpegjTerminal mpegjTerminal;
    Scene m_scene;
    MySceneListener m_sceneListener;
    MyTranslate m_translate;
    MyEventOutListener m_eventoutListener;
    MyNodeCreator m_nodeCreator;
    // other declarations

    public void init()
    {
        mpegjTerminal = new MpegjTerminal(MPEGlet);
        // all the initialization goes here for net and resource
        //managers

        //getting a reference to the Scene object from the //MpegjTerminal object
        try {
            m_scene = m_sceneListener.getScene( mpegjTerminal );
        }catch( MPEGJException mpegj_exp ) { }
        catch ( InterruptedException ie ) { }
    }

    public void run() {
        //to access and modify a field in the BIFS scene
        try {
            m_translate.translate(m_scene);
        }catch( MPEGJException mpegj_exp ) { }

        //to receive notifications of changes to the scene
        try {
            m_eventoutListener.register(m_scene);
        }catch( MPEGJException mpegj_exp ) { }

        // creating and adding a new node (in this case, a Box node) to //the Scene
        try {
            m_modeCreator.createBox(m_scene);
        }catch( MPEGJException mpegj_exp ) { }
    }
}

```

```

    public void stop(){}
    public void destroy(){}
}

```

T.1.1 MySceneListener

The Scene object is the sole entry point for accessing and modifying the BIFS scene. This example shows how to get a reference to the Scene object from the MpegjTerminal object.

```

import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.scene.*;

/**
 * Gets the scene from the MpegjTerminal.
 */
public class MySceneListener implements SceneListener {
    private Scene m_scene;

    /**
     * Waits for and returns the scene associated with the given MpegjTerminal.
     *
     * @param terminal the MpegjTerminal containing the scene
     * @return the scene
     * @exception MPEGJException if an MPEG-J failure occurs
     * @exception InterruptedException if interrupted while waiting for the
     * scene
     */
    public synchronized Scene getScene(MpegjTerminal terminal)
        throws MPEGJException, InterruptedException {
        SceneManager mgr = terminal.getSceneManager();

        mgr.addSceneListener(this);

        while (m_scene == null) {
            wait();
        }

        return m_scene;
    }
    /**
     * Called back by the SceneManager to provide the scene.
     */
    public synchronized void notify(int what, Scene scene) {
        if (what == SceneListener.Message.SCENE_READY) {
            m_scene = scene;
            notify();
        }
    }
}

```

T.1.2 MyTranslate

This example shows how to access and modify a field in the BIFS scene. Firstly, the value of the translation field of a Transform2D node is printed out. Secondly, the example modifies the translation field by sending a new value to its eventIn. Note that a reference to the Transform2D node was obtained by calling the `scene.getNode()` method with a parameter of 1, which must correspond to the DEF ID of the Transform2D node in the scene.

```

import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.scene.*;

/**
 * Translates the translation field of a DEF 1 Transform2D node.

```

```

/*
public class MyTranslate {
    /**
     * Translates the translation field of node 1.
     *
     * @param scene the scene
     * @exception MPEGJException if an MPEG-J failure occurs
     */
    public void translate(Scene scene) throws MPEGJException {
        Node node = scene.getNode(1);

        // Check that the node is a Transform2D.
        if (node.getNodeType() != NodeType.Transform2D) {
            System.err.println("Node 1 is not a Transform2D!");
            return;
        }

        // Get the current translation and print it.
        int outID = EventOut.Transform2D.translation;
        SFVec2fFieldValue translationEventOut =
            (SFVec2fFieldValue) node.getEventOut(outID);
        float[] translation = translationEventOut.getSFVec2fValue();
        System.out.println("Node 1 translation is " +
            translation[0] + "," + translation[1]);

        // Calculate a new translation.
        final float[] newTranslation = {
            translation[0] + 2,
            translation[1] + 2
        };

        // Set the new translation via the eventIn.
        int inID = EventIn.Transform2D.translation;
        SFVec2fFieldValue translationEventIn =
            new SFVec2fFieldValue() {
                public float[] getSFVec2fValue() {
                    return newTranslation;
                }
            };
        node.sendEventIn(inID, translationEventIn);
    }
}

```

T.1.3 MyEventOutListener

This example shows how to receive notifications of changes to the scene. The MyEventOutListener object registers as a listener of the fraction_changed field of a TimeSensor node. When the field value changes, the notify() method of the MyEventOutListener object is called with the new value.

```

import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.scene.*;

/**
 * Listens to the fraction_changed field of a DEF 2 TimeSensor.
 */
public class MyEventOutListener implements EventOutListener {
    /**
     * Registers as a listener on the fraction_changed field.
     *
     * @param scene the scene
     * @exception MPEGJException if an MPEG-J failure occurs
     */
    public void register(Scene scene) throws MPEGJException {

```

```

        Node node = scene.getNode(2);

        // Check that the node is a TimeSensor.
        if (node.getNodeType() != NodeType.TimeSensor) {
            System.err.println("Node 2 is not a TimeSensor!");
            return;
        }

        // Add ourselves as a listener.
        node.addEventOutListener(EventOut.TimeSensor.fraction_changed, this);
    }

    /**
     * Called back when the fraction_changed field changes.

     @param outID the eventOut identifier
     @param newValue the new value of the field
    */
    public void notify(int outID, FieldValue newValue) {
        float fractionChanged = ((SFFloatFieldValue) newValue).getSFFloatValue();
        System.out.println("fraction_changed=" + fractionChanged);
    }
}

```

T.1.4 MyNodeCreator

This example demonstrates how a new node (in this case, a Box node) can be created and added to the scene. This is achieved by setting the value of a SFNode field with an object implementing the NewNode interface. This example uses a utility class called MyNewNode that implements the NewNode interface. The MyNewNode class exposes the attributes of the Box node including its node type, DEF ID and field values (in particular, the size field). The value of the size field is represented using another utility class called MySFVec3f that implements the SFVec3fFieldValue interface. Once the MyNewNode object has been created, it can be added to the scene by sending it as an eventIn to the geometry field of a Shape node.

```

import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.scene.*;
import java.util.Hashtable;

/**
 * Sets the geometry of a DEF 3 Shape node to a Box node with size 2,3,4.
 * Uses two extra utility classes: MySFNode and MySFVec3f.
 */
public class MyNodeCreator {
    public void createBox(Scene scene) throws MPEGJException {
        Node shapeNode = scene.getNode(3);

        // Create the representation of the Box node.
        MyNewNode box = new MyNewNode(NodeType.Box, 0);

        // Add the size field to the representation.
        box.setField(Field.Box.size, new MySFVec3f(2, 3, 4));

        // Send the Box node as an eventIn to the geometry field.
        shapeNode.sendEventIn(EventIn.Shape.geometry, box);
    }
}

/**
 * Utility class to represent a new node.
 */
class MyNewNode implements SFNodeFieldValue, NewNode {
    int m_type;
    int m_id;
}

```

```

Hashtable m_fields = new Hashtable();
NodeValue m_value;

MyNewNode(NodeValue value) {
    m_value = value;
}

MyNewNode(int type, int id) {
    m_type = type;
    m_id = id;
    m_value = this;
}

void setField(int defID, FieldValue value) {
    m_fields.put(new Integer(defID), value);
}

public NodeValue getSFNodeValue() {
    return m_value;
}

public int getNodeType() {
    return m_type;
}

public int getNodeID() {
    return m_id;
}

public FieldValue getField(int defID) {
    return (FieldValue) m_fields.get(new Integer(defID));
}
}

/**
 * Utility class to represent an SFVec3f.
 */
class MySFVec3f implements SFVec3fFieldValue {
    float[] m_value;

    MySFVec3f(float x, float y, float z) {
        m_value = new float[] { x, y, z };
    }

    public float[] getSFVec3fValue() {
        return m_value;
    }
}

```

T.2 Resource and Decoder APIs

Examples in this section show how the ResourceManager and Decoder APIs can be used to monitor resources and adapt to time varying resource conditions.

```

import org.iso.mpeg.mpegj.resourceManager.*;
import org.iso.mpeg.mpegj.decoder.*;
import org.iso.mpeg.mpegj.scene.*;
import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.net.*;

public class RM_Example implements MPEGlet
{
    MpegjTerminal mpegjTerminal;

```

```

private ResourceManager resourceManager;
RendererEventHandler renderer_EH;
DecoderEventHandler decoder_EH;
// other declarations

Node m_node;
Renderer m_renderer;
java.util.Vector m_decoders;

public void RM_Example() {
    m_decoders = new java.util.Vector( 3, 3 );
}

public void init()
{
    // initialize the mpegjterminal
    mpegjTerminal = new MpegjTerminal(MPEGlet);

    // other initializations go here

    // get resource manager from the mpegjterminal
    try
    {
        resourceManager = mpegjTerminal.getResourceManager();
    }catch(MPEGJException ex){ }

    // create event handlers for renderer and decoders
    renderer_EH = new EventHandler();
    decoder_EH = new EventHandler();

    // getting the renderer from the Resource Manager
    try {
        m_renderer = resourceManager.getRenderer();
    } catch( RendererNotFoundException rnf ) { }

    // to add event listener to the Renderer
    if( m_renderer != null )
        m_renderer.addMPRendererMediaListener(renderer_EH);

    // to get the required decoder from the resource manager
    try {

        MPdecoderImp decl =
            resourceManager.getDecoder(m_node);

        // registering the decoder as listener to the events
        decl.addMPDecoderMediaListener(decoder_EH);

    } catch( DecoderNotFoundException dnfe) { }
    catch (BadNodeException bne) { }

        // to change a decoder associated with a node
        // get a decoder from the available decoders list
        MPdecoder decoder = resourceManager.getAvailableDecoder(
                            decoder_type );

        try {
            resourceManager.changeDecoder( node, decoder)
        }catch ( DecoderNotFoundException dnfe ) { }
        catch( BadNodeException bne) { }

    // to stop a decoder and restarting again
}

```

```

        decoder.stop();
        decoder.start();

        // to retrieve all capabilities (static, dynamic, profile) of // the
        terminal
        try {
            CapabilityManager cm =
                resourceManager.getCapabilityManager();
        }catch (CapabilityManagerNotFoundException cmnfe ) { }
        // other code goes here
    }
    public void stop(){}
    public void destroy(){}
}

}

```

T.2.1 Listener class for Decoder Events :

```

import org.iso.mpeg.mpegj.resourceManager.*;
import org.iso.mpeg.mpegj.decoder.*;

public class DecoderEventHandler implements MPDecoderMediaListener{
    public void mPDecoderMediaHandler(MPDecoderMediaEvents event) {
        MPDecoderImp dec = ((MPDecoderImp)event.getSource());

        int condition = event.getCondition();
        System.out.println("Event in Decoder with condition "+ condition );
        // we can stop the decoder and restart it again
        dec.stop();
        // can change the decoder if we want
        // restart it again
        dec.start();
    }
    public DecoderEventHandler( ) {
        super();
    }
}

```

T.2.1 Listener class for Renderer Events

```

import org.iso.mpeg.mpegj.resourceManager.*;
public class RendererEventHandler implements MPRendererMediaListener{
    public void mPCompositeMediaHandler(MPRendererMediaEvents event){
        System.out.println("Renderer Event with condition "+event.getCondition() );
        // other code goes here
    }
    public RendererEventHandler( ) {
        super();
    }
}

```

T.3 Net APIs

This section illustrates how to use the Net APIs through a simple example which enables and disables channels.

```

import org.iso.mpeg.mpegj.resourceManager.*;
import org.iso.mpeg.mpegj.scene.*;
import org.iso.mpeg.mpegj.*;
import org.iso.mpeg.mpegj.net.*;

public class Net_Example implements MPEGlet
{

```

```

MpegjTerminal mpegjTerminal;
private NetworkManager netManager;
ChannelController cc;
public void Net_Example() {
}
public void init()
{
    mpegjTerminal = new MpegjTerminal(MPEGlet);
    try
    {
        netManager = mpegjTerminal.getNetworkManager();
    } catch(NetworkManagerNotFoundException ex){ }
    catch(MPEGJException ex){ }

    // to get the channel controller used to enable/ disable //the channels
    cc = netManager.getChannelController();
    // to enable a channel
    cc.enable( serviceSessionID, channelID);
    // to disable a channel
    cc.disable( serviceSessionID, channelID);

}
public void stop(){}
public void destroy(){}
}

```

T.4 Section Filtering APIs

This shows a simple example of how the section information can be extracted from the MPEG-2 Transport Stream.

```

import org.iso.mpeg.mpegj.*;
import java.lang.Boolean;

public class SI_SF_Example implements MPEGlet
{
    MpegjTerminal mpegjTerminal;
    SimpleSectionFilter ssFilter;
    SectionFilterListener sfListener;
    int milliSecs;

    // Class public methods
    public SI_SF_Example() {

        // initialize the mpegjterminal
        mpegjTerminal = new MpegjTerminal(this);
        // other initializations go here

        ssFilter = new SimpleSectionFilter();
        sfListener = new SectionFilterListener();

        // Specify an object to be notified of events relating to this SectionFilter
        // object.
        ssFilter.addSectionFilterListener( sfListener);

        // Set the time-out for this section filter
        ssFilter.setTimeOut( milliSecs);

        // create mask and value parameters
        byte[] posValue = new byte[12];
        byte[] posMask  = new byte[12];
        for ( int i=0; i<12; i++ )
        {   posValue[i] = 0;
            posMask[i]  = 0;
        }
    }
}

```

```

}

posMask[0] = (byte)0xFF; // only check first byte
posValue[0] = (byte)0; // table_id PAT

//sets the SectionFilter object as filtering only for sections matching a
specific PID and
//table_id, and where contents of the section match the specified filter pattern.
ssFilter.startFilter
    ( 0          // index, the number of this section filter
    , 100        // id, uniquely identifying this filter action
    , ssFilter   // the listener to receive the events indicating a new
section has arrived
    , 0          // PID, in the case of the PAT 0
    , posMask    // mask, which bits to check
    , posValue   // value, the value checked bits should have
    , null       // neg masking not done, always call this function in
SommitSectionFilter, other startfilter methods are incorrect.
    , null
);

Section m_section = ssFilter.getSection()
try {
    byte[] m_data = m_section.getData();
} catch (NoDataAvailableException ndae) { }

// sections matching this SectionFilter object will stop.
ssFilter.stopFiltering();
}
public void init() {}
public void stop(){}
public void destroy(){}
}

```

Annex U
(Normative)

MPEG-J APIs Listing (HTML)

This is a normative annex containing the javadocs of the MPEG-J APIs in the HTML format. This is included in the electronic attachment to this Amendment.

Annex V (Normative)

MPEG-J APIs Listing

This is a normative annex containing the javadocs of the MPEG-J APIs. The API documentation was automatically generated from Java sources of the specified MPEG-J APIs.

| Package Summary | |
|--|---|
| Packages | |
| <u>Package org.iso.mpeg.mpeqj</u> | Access to MpegjTerminal which sets the namescope and provides the managers for all the other categories (ResourceManager, SceneManager, etc.) |
| <u>Package org.iso.mpeq.mpeqj.decoder</u> | Access and control to the decoders used to decode the audio-visual objects. |
| <u>Package org.iso.mpeq.mpeqj.net</u> | Access and control of the network components of the MPEG-4 player. |
| <u>Package org.iso.mpeq.mpeqj.resource</u> | Centralized facility for managing system resources |
| <u>Package org.iso.mpeq.mpeqj.scene</u> | Access to the static and dynamic capabilities of the terminal. |
| | Means by which MPEG-J applications access and manipulate the scene graph |

V.1 package org.iso.mpeg.mpeqj

V.1.1 Description

| Class Summary | |
|--------------------------------|---|
| Interfaces | |
| <u>DecoderConfigDescriptor</u> | interface for DecoderConfigDescriptor |
| <u>ObjectDescriptor</u> | interface for ObjectDescriptor |
| <u>MPEGlet</u> | This the interface that has to be implemented by a remote MPEG-J Application. |
| <u>ESDescriptor</u> | interface for ESDescriptor |
| Classes | |
| <u>MpegjTerminal</u> | MPEG-J Terminal class. |
| Exceptions | |
| <u>MPEGJException</u> | The class MPEGJException is a subclass of java.lang.Exception and is the parent of all MPEG-J Exceptions. |
| <u>NetworkManagerNotFound</u> | |
| <u>SceneManagerNotFound</u> | |

V.1.2 org.iso.mpeg.mpeqj.DecoderConfigDescriptor

V.1.2.1 Syntax

```
public interface DecoderConfigDescriptor
    Description
    interface for DecoderConfigDescriptor
```

| Member Summary | |
|-----------------------|----------------------------------|
| Methods | |
| int | <u>getStreamType()</u> |
| int | <u>getAvgBitRate()</u> |
| int | <u>getBuffersizeDB()</u> |
| int | <u>getMaxBitrate()</u> |
| int | <u>getObjectTypeIndication()</u> |

V.1.2.2 Methods

getavgBitRate()
public int getavgBitRate()

Returns average bitrate in bits per second of this elementary stream

Returns:

average bit rate

getBuffersizeDB()
public int getBuffersizeDB()

Returns the size of the decoding buffer for this elementary stream in byte

Returns:

size of the buffer

getmaxBitrate()
public int getmaxBitrate()

Returns the maximum bitrate in bits/second of this elementary stream

Returns:

maximum bitrate

getObjectTypeIndication()
public int getObjectTypeIndication()

Returns the indication of the object or scene description type

Returns:

value representing the object or scene description type that needs to be supported by the decoder for this elementary stream

getStreamType()
public int getStreamType()

Returns the type of this elementary stream

Returns:

stream type value

V.1.3 org.iso.mpeg.mpegj.ESDescriptor

V.1.3.1 Syntax

```
public interface ESDescriptor
```

V.1.3.2 Description

interface for ESDescriptor

| Member Summary | |
|-----------------------|--|
| Methods | int getESID() boolean isStreamDependent() int getdependsOn_ESID() int getStreamPriority() DecoderConfigDescriptor getDecoderConfigDescriptor() |

V.1.3.3 Methods

getDecoderConfigDescriptor()

public [org.iso.mpeg.mpegj.DecoderConfigDescriptor](#) getDecoderConfigDescriptor()

Returns the decoder config Descriptor

Returns: DecoderConfigDescriptor

getdependsOn_ESID()

```
public int getdependsOn_ESID()
```

Returns the ESID of another elementary stream on which this elementary stream depends.

Returns:

ESID or -1 if the stream is not dependent on another

getESID()

```
public int getESID()
```

Returns the ID associated with this ESDescriptor

Returns:

ESID

getStreamPriority()

```
public int getStreamPriority()
```

Returns the relative measure for the priority of this stream. An elementary stream with higher stream priority is more important than one with a lower stream priority.

Returns:

priority

isStreamDependent()

```
public boolean isStreamDependent()
```

Returns whether this elementary stream depends another elementary stream

Returns:

true or false

V.1.4 org.iso.mpeg.mpegj.MPEGJException

V.1.4.1 Syntax

```
public class MPEGJException extends java.lang.Exception  
  
java.lang.Object  
|  
+--java.lang.Throwable  
|  
+--java.lang.Exception  
|  
+--org.iso.mpeg.mpegj.MPEGJException
```

Direct Known Subclasses:

[org.iso.mpeg.mpegj.net.AccessLayerException](#),

[org.iso.mpeg.mpegj.scene.BadNodeException](#),

[org.iso.mpeg.mpegj.scene.BadParameterException](#),

[org.iso.mpeg.mpegj.resource.CapabilityManagerNotFoundException](#),

[org.iso.mpeg.mpegj.resource.IllegalDecoderMediaEventsException](#),

[org.iso.mpeg.mpegj.resource.IllegalRendererMediaEventsException](#),

[org.iso.mpeg.mpegj.resource.IllegalStreamMediaEventsException](#),

[org.iso.mpeg.mpegj.scene.InvalidNodeException](#),

[org.iso.mpeg.mpegj.scene.InvalidSceneException](#),

[org.iso.mpeg.mpegj.decoder.MediaDecoderException](#), [org.iso.mpeg.mpegj.resource.RendererNotFoundException](#), [org.iso.mpeg.mpegj.resource.ResourceManagerNotFoundException](#)

All Implemented Interfaces:

java.io.Serializable

V.1.4.2 Description

The class MPEGJException is a subclass of java.lang.Exception and is the parent of all MPEG-J Exceptions.

| Member Summary | |
|-----------------------|--|
| Constructors | |
| | MPEGJException() |
| | MPEGJException(String) |

V.1.4.3 Constructors

MPEGJException()

public MPEGJException()

Constructs an MPEGJException with no specified detail message.

MPEGJException(String)

public MPEGJException(java.lang.String)

Constructs an MPEGJException with a detailed message.

V.1.5 org.iso.mpeg.mpegj.MpegjTerminal

V.1.5.1 Syntax

```
public class MpegjTerminal extends java.lang.Object
    java.lang.Object
    |
    +-org.iso.mpeg.mpegj.MpegjTerminal
```

V.1.5.2 Description

MPEG-J Terminal class. This class provides the information about the managers that are implemented in the terminal. Each applet or application instantiates a new environment once it is loaded.

| Member Summary | |
|-----------------------|--|
| Constructors | |
| | MpegjTerminal() |
| | MpegjTerminal(MPEGlet) |
| Methods | |
| ResourceManager | getResourceManager() |
| SceneManager | getSceneManager() |
| NetworkManager | getNetworkManager() |
| ObjectDescriptor | getInitOD() |
| Vector | getODs(int) |

V.1.5.3 Constructors

MpegjTerminal()

public MpegjTerminal()

Constructor for the MpegjTerminal. This constructor may only be used by local applications.

Throws:

SecurityException - Thrown if this method is called by a non-local application.

MpegjTerminal(MPEGlet)

public MpegjTerminal([org.iso.mpeg.mpegj.MPEGlet](#))

Constructor for the MpegjTerminal. This constructor may be called by an MPEGlet to indicate the name scope in which this MPEG-J Terminal object should operate.

Parameters:

mpeglet - the MPEGlet that identifies the name scope to use.

Throws:

SecurityException - Thrown if this method is called by an unrecognized caller.

V.1.5.4 Methods

getinitOD()

public org.iso.mpeg.mpegj.ObjectDescriptor getinitOD()

Returns initOD associated with the scene

Returns:

ObjectDescriptor

getNetworkManager()

public org.iso.mpeg.mpegj.net.NetworkManager getNetworkManager()

Obtain the NetworkManager used to get all the information related to a DMIF session and to enable/disable DMIF channels.

Returns:

the NetworkManager if available.

Throws:

org.iso.mpeg.mpegj.NetworkManagerNotFoundException - Thrown when the NetworkManager is not available.

getODs(int)

public java.util.Vector getODs(int)

Returns the vector of ODs associated to that scene that were received by the OD stream.

Parameters:

int - initOD

Returns:

vector of Object Descriptors

getResourceManager()

public org.iso.mpeg.mpegj.resource.ResourceManager getResourceManager()

Obtain the ResourceManager.

Returns:

the ResourceManager if available.

Throws:

org.iso.mpeg.mpegj.resource.ResourceManagerNotFoundException - Thrown when the ResourceManager is not available.

getSceneManager()

public org.iso.mpeg.mpegj.scene.SceneManager getSceneManager()

Obtain the SceneManager.

Returns:

the SceneManager if available.

Throws:

org.iso.mpeg.mpegj.SceneManagerNotFoundException - Thrown when the SceneManager is not available.

V.1.6 org.iso.mpeg.mpegj.MPEGlet

V.1.6.1 Syntax

```
public interface MPEGlet extends java.lang.Runnable
```

All Superinterfaces:

java.lang.Runnable

V.1.6.2 Description

This is the interface that has to be implemented by a remote MPEG-J Application. This methods in this interface are very similar syntactically and semantically to the Applet Class, except that this is an interface and it extends the Runnable interface, so that it can be executed as separate thread. Note that there is no start method. This is because run() of the Runnable interface is used instead of start

| Member Summary | |
|-----------------------|---------------------------|
| Methods | |
| void | init() |
| void | stop() |
| void | destroy() |

V.1.6.3 Methods

destroy()

```
public void destroy()
```

Called by the MPEG-J player to inform the MPEGlet that is being reclaimed and that it should destroy any resources it has allocated. The stop method will always be called before destroy. Any operations before it is destroyed should go in here.

init()

```
public void init()
```

Called by the MPEG-J player to inform the MPEGlet that it has been loaded into the system. This is always called before the first time the MPEGlet is run as a separate by calling the run() method. Any initialization goes here.

stop()

```
public void stop()
```

Called by the MPEG-J player to inform the MPEGlet that it should stop its execution. This is always called before destroy() is called. This can also be called anytime the execution of the MPEGlet has to be stopped. Any operations before it is stopped should go in here.

V.1.7 org.iso.mpeg.mpegj.NetworkManagerNotFoundException

V.1.7.1 Syntax

```
public class NetworkManagerNotFoundException extends java.lang.Exception
    java.lang.Object
        |
        +--java.lang.Throwable
            |
            +--java.lang.Exception
                |
                +--org.iso.mpeg.mpegj.NetworkManagerNotFoundException
```

All Implemented Interfaces:

java.io.Serializable

V.1.7.2 Description

| Member Summary | |
|-----------------------|---|
| Constructors | |
| | NetworkManagerNotFoundException() |

V.1.7.3 Constructors

NetworkManagerNotFoundException()

```
public NetworkManagerNotFoundException()
```

V.1.8 org.iso.mpeg.mpegj.ObjectDescriptor**V.1.9 Syntax**

```
public interface ObjectDescriptor
```

V.1.9.1 Description

interface for ObjectDescriptor

| Member Summary | |
|-----------------------|--------------------------------------|
| Methods | |
| int | <code>getObjectDescriptorID()</code> |
| Vector | <code>getESDescriptors()</code> |
| ESDescriptor | <code>getESDescriptor(int)</code> |
| String | <code>getURL()</code> |

V.1.9.2 Methods**getESDescriptor(int)**

```
public org.iso.mpeg.mpegj.ESDescriptor getESDescriptor(int)
```

Returns the ESDescriptor associated with the given ESIID

Parameters:

ESDescriptor - ID

Returns:

ESDescriptor object

getESDescriptors()

```
public java.util.Vector getESDescriptors()
```

Returns the ESDescriptors associated with this ObjectDescriptor

Returns:

vector of ESDescriptors

getObjectDescriptorID()

```
public int getObjectDescriptorID()
```

Returns the ID associated with this Object Descriptor

Returns:

ObjectDescriptorID

getURL()

```
public java.lang.String getURL()
```

Returns the URL String

Returns:

String

V.1.10 org.iso.mpeg.mpegj.SceneManagerNotFoundException**V.1.10.1 Syntax**

```
public class SceneManagerNotFoundException extends java.lang.Exception
```

```
java.lang.Object
```

```
|
```

```
+--java.lang.Throwable
```

```
|
```

```
+--java.lang.Exception
```

```
|
```

```
+--org.iso.mpeg.mpegj.SceneManagerNotFoundException
```

All Implemented Interfaces:

java.io.Serializable

V.1.10.2 Description

| Member Summary | |
|----------------|---|
| Constructors | SceneManagerNotFoundException() |

V.1.10.3 Constructors

SceneManagerNotFoundException()
 public SceneManagerNotFoundException()

V.2 package org.iso.mpeg.mpegj.resource**V.2.1 Description**

| Class Summary | |
|--|--|
| Interfaces | |
| MPRendererFrameEventGenerator | An interface for adding and removing frame event listeners. |
| Dimension | Interface for Dimension with set and get methods for Width and Height |
| StaticCapability | This interface is used to provide developers a simple way to access basic dynamic terminal capabilities. |
| MPRendererMediaListener | An interface that is called by the renderer when registered. |
| MPRendererEventGenerator | An interface for adding and removing Renderer event listeners. |
| TerminalProfileManager | This interface allows applications to query the terminal profiles. |
| Renderer | Interface for the Rendering Engine. |
| DynamicCapabilityObserver | Interface to observe Dynamic capabilities. |
| MPDecoderMediaListener | An interface that is called by an MPDecoder when registered. |
| DynamicCapability | This interface is used to provide developers a simple way to access basic dynamic terminal capabilities. |
| MPDecoderEventGenerator | An interface for adding and removing Decoder event listeners. |
| MPRendererFrameListener | An interface that is called periodically by the renderer. |
| Classes | |
| MPDecoderMediaEvents | An event object that is given to an MPDecoderMediaListener. |
| MPDecoderEventGeneratorImp | An interface for adding and removing Decoder event listeners. |
| MPRendererFrameEvents | An event object that is given to an MPRendererFrameListener. |
| CapabilityManager | A CapabilityManager monitors latency and bandwidth of network connections and manages peripheral devices. |
| ResourceManager | The resource manager is used for regulation of performance. |
| CapabilityInfo | This class is used to store information related to dynamic observers. |
| MPRendererMediaEvents | An event object that is given to an MPRendererMediaListener. |
| CPUmonitor | The CPUmonitor class is used to monitor selected terminal activities including CPU load, and free/available system memory utilisation. |
| CapabilityObserver | This class is used to store information related to dynamic observers. |
| Exceptions | |
| IllegalDecoderMediaEventsException | |
| ResourceManagerNotFoundException | The class ResourceManagerNotFoundException is a subclass of MPEGJException. |
| RendererNotFoundException | The class RendererNotFoundException is a subclass of MPEGJException. |
| IllegalStreamMediaEventsException | |

| | |
|------------------------------|---|
| <u>CapabilityManagerNot-</u> | The class CapabilityManagerNotFoundException is a subclass of |
| <u>FoundException</u> | MPEGJException. |
| <u>IllegalRendererMedi-</u> | This a subclass of MPEGJException. |
| <u>aEventsException</u> | |

V.2.2 org.iso.mpeg.mpegj.resource.CapabilityInfo

V.2.2.1 Syntax

```
public class CapabilityInfo extends java.lang.Object
    java.lang.Object
    |
    +-org.iso.mpeg.mpegj.resource.CapabilityInfo
```

V.2.2.2 Description

This class is used to store information related to dynamic observers.

| Member Summary | | | |
|-----------------------|--|---------|------------------------------------|
| Constructors | <u>CapabilityInfo(Observer, long, boolean)</u> | | |
| Methods | <table> <tr> <td>boolean</td> <td><u>verifyCapabilityValue(long)</u></td> </tr> </table> | boolean | <u>verifyCapabilityValue(long)</u> |
| boolean | <u>verifyCapabilityValue(long)</u> | | |

V.2.2.3 Constructors

CapabilityInfo(Observer, long, boolean)

```
public CapabilityInfo(java.util.Observer, long, boolean)
```

V.2.2.4 Methods

verifyCapabilityValue(long)

```
public boolean verifyCapabilityValue(long)
```

Verify Capability Value

Parameters:

value - the capability value that has to be verified

Returns:

true is the passed value exceeds the threshold, false otherwise.

V.2.3 org.iso.mpeg.mpegj.resource.CapabilityManager

V.2.3.1 Syntax

```
public class CapabilityManager extends java.lang.Object implements
    org.iso.mpeg.mpegj.resource.DynamicCapability,
    org.iso.mpeg.mpegj.resource.StaticCapability,
    org.iso.mpeg.mpegj.resource.DynamicCapabilityObserver,
    org.iso.mpeg.mpegj.resource.TerminalProfileManager
    java.lang.Object
    |
    +-org.iso.mpeg.mpegj.resource.CapabilityManager
```

All Implemented Interfaces:

org.iso.mpeg.mpeqj.resource.DynamicCapability,
org.iso.mpeg.mpeqj.resource.DynamicCapabilityObserver,
org.iso.mpeg.mpeqj.resource.StaticCapability,
org.iso.mpeg.mpeqj.resource.TerminalProfileManager

V.2.3.2 Description

A CapabilityManager monitors latency and bandwidth of network connections and manages peripheral devices.

Functionality:

Interacts with DMIF.

Interacts with presentation devices.

Throws profile exceptions.

Interacts with input devices.

Throws MPEG4Events.

The CapabilityManager class handles capability through the CapabilityManager. The CapabilityManager offers a simple and generic way to handle capabilities. The CapabilityManager implements some interfaces in order to simplify developers work when basic capabilities need to be managed. [An interface encapsulates a coherent set of services and attributes, i.e. a Role, without explicitly binding this function to that of any particular object or code]. The interfaces are:

DynamicCapability This interface is used to provide developers a simple way to access basic dynamic terminal capabilities. A capability is dynamic if it can change value/status at runtime. For instance memory usage is a dynamic capability.

StaticCapability This interface is used to provide developers a simple way to access basic static terminal capabilities. A capability is considered static if its value/static cannot change at runtime. For instance the audio card type is a static capability.

CapabilityObserver This interface is used to provide developers a few methods that allow them to simply monitor the value of common capabilities such as memory and resource usage.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>CapabilityManager()</u> |
| Methods | <u>void notifyApplicationFreeMemory(long, Observer)</u> <u>void notifyTerminalFreeMemory(long, Observer)</u> <u>void notifyTerminalLoad(long, Observer)</u> <u>void notifyTerminalNetworkLoad(long, Observer)</u> <u>void deleteObserver(Observer)</u> <u>int getNumCPUs()</u> <u>int getCPUSpeed(int)</u> <u>String getCPUType(int)</u> <u>String getMouseType()</u> <u>int getDisplayColorDepth()</u> <u>String getDisplayType()</u> <u>String getKeyboardType()</u> <u>String getNetworkType()</u> <u>int getNumParallelPorts()</u> <u>int getNumSerialPorts()</u> <u>Dimension screenSize()</u> <u>short screenDepth()</u> <u>short screenResolution()</u> <u>String getOSLanguage()</u> <u>String getOSType()</u> <u>String getTerminalArchitecture()</u> <u>String[] getAudioDrivers()</u> <u>String[] getMIDIDrivers()</u> <u>String[] getVideoDrivers()</u> <u>String getModemType()</u> |

| | |
|-------|-------------------------------------|
| long | <u>getFreeTerminalMemory()</u> |
| long | <u>getTotalTerminalMemory()</u> |
| long | <u>getTotalApplicationMemory()</u> |
| long | <u>getFreeApplicationMemory()</u> |
| long | <u>getTerminalLoad()</u> |
| long | <u>getNetworkLoad()</u> |
| short | <u>getSceneDescriptionProfile()</u> |
| short | <u>getVisualProfile()</u> |
| short | <u>getAudioProfile()</u> |

V.2.3.3 Constructors

CapabilityManager()

public CapabilityManager()

V.2.3.4 Methods

deleteObserver(Observer)

public void deleteObserver(java.util.Observer)

deleteObserver

Specified By:

deleteObserver(Observer) in interface org.iso.mpeg.mpeqj.resource.DynamicCapability-Observer

Parameters:

objToDeregister - observer object previously registered using registerXXX methods

getAudioDrivers()

public java.lang.String[] getAudioDrivers()

Terminal Audio Enc/Dec

Specified By:

getAudioDrivers() in interface org.iso.mpeg.mpeqj.resource.StaticCapability

Returns:

the available audio drivers.

getAudioProfile()

public short getAudioProfile()

Specified By:

getAudioProfile() in interface org.iso.mpeg.mpeqj.resource.TerminalProfileManager

getCPUSpeed(int)

public int getCPUSpeed(int)

Terminal CPU Speed

Specified By:

getCPUSpeed(int) in interface org.iso.mpeg.mpeqj.resource.StaticCapability

Returns:

the speed of the 'idx' CPU or -1 is an error occurs

getCPUType(int)

public java.lang.String getCPUType(int)

Terminal CPU type (Pentium for instance)

Specified By:

getCPUType(int) in interface org.iso.mpeg.mpeqj.resource.StaticCapability

Parameters:

idx - the index of the CPU (idx >= 0)

Returns:

the type of CPU

Throws:

`IllegalArgumentException` - the index is either negative or out of range.

getDisplayColorDepth()

`public int getDisplayColorDepth()`

Terminal Display Color Depth

Specified By:

`getDisplayColorDepth()` in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the display color depth (bits per pixel)

getDisplayType()

`public java.lang.String getDisplayType()`

Terminal Display Type (e.g. VGA)

Specified By:

`getDisplayType()` in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the display type

getFreeApplicationMemory()

`public long getFreeApplicationMemory()`

Free application memory (RAM)

Specified By:

`getFreeApplicationMemory()` in interface [org.iso.mpeg.mpegj.resource.DynamicCapability](#)

Returns:

the amount of available (at application level e.g. JavaVM) free memory (bytes).

getFreeTerminalMemory()

`public long getFreeTerminalMemory()`

Terminal free memory (RAM)

Specified By:

`getFreeTerminalMemory()` in interface [org.iso.mpeg.mpegj.resource.DynamicCapability](#)

Returns:

the amount of free memory (bytes) installed on the terminal.

getKeyboardType()

`public java.lang.String getKeyboardType()`

Terminal Keyboard Type

Specified By:

`getKeyboardType()` in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the keyboard type, NULL if the keyboard is not present.

getMIDIDrivers()

`public java.lang.String[] getMIDIDrivers()`

Terminal MIDI Enc/Dec

Specified By:

`getMIDIDrivers()` in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the available MIDI drivers.

getModemType()

`public java.lang.String getModemType()`

Terminal modem type

Specified By:

`getModemType()` in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the modem speed ("28K", "56K" etc.) or "" is the modem is not installed.

getMouseType()

```
public java.lang.String getMouseType()
```

Terminal Mouse Type

Specified By:

getMouseType() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the mouse type or null if an error occurred

getNetworkLoad()

```
public long getNetworkLoad()
```

Terminal Network Load

Specified By:

getNetworkLoad() in interface [org.iso.mpeg.mpeqj.resource.DynamicCapability](#)

Returns:

the network load (percentage).

getNetworkType()

```
public java.lang.String getNetworkType()
```

Terminal Network Type

Specified By:

getNetworkType() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the network type or null if an error occurred.

getNumCPUs()

```
public int getNumCPUs()
```

Number of Terminal CPUs

Specified By:

getNumCPUs() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the number of CPUs that equip the terminal or -1 is an error occurs

getNumParallelPorts()

```
public int getNumParallelPorts()
```

Terminal parallel IEEE-1284 port(s)

Specified By:

getNumParallelPorts() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the number of parallel ports present on the terminal.

getNumSerialPorts()

```
public int getNumSerialPorts()
```

Terminal serial RS-232 port(s)

Specified By:

getNumSerialPorts() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the number of serial ports present on the terminal.

getOSLanguage()

```
public java.lang.String getOSLanguage()
```

Terminal OS language

Specified By:

getOSLanguage() in interface [org.iso.mpeg.mpeqj.resource.StaticCapability](#)

Returns:

the language of the OS version installed on the terminal.

getOSType()

```
public java.lang.String getOSType()
```

Terminal OS type (for instance JavaPC, Windows, MacOS)

Specified By:

getOSType() in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the OS type installed on the terminal.

getSceneDescriptionProfile()

```
public short getSceneDescriptionProfile()
```

Scene Description Profile

Specified By:

getSceneDescriptionProfile() in interface [org.iso.mpeg.mpegj.resource.TerminalProfileManager](#)

Returns:

the actual scene description profile.

getScreenDepth()

```
public short getScreenDepth()
```

Terminal screen depth

Specified By:

getScreenDepth() in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the screen depth (bits/inch)

getScreenResolution()

```
public short getScreenResolution()
```

Terminal screen resolution

Specified By:

getScreenResolution() in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the screen resolution (dots/inch)

getScreenSize()

```
public org.iso.mpeg.mpegj.resource.Dimension getScreenSize()
```

Terminal screen size

Specified By:

getScreenSize() in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the screen size (pixel x pixel)

getTerminalArchitecture()

```
public java.lang.String getTerminalArchitecture()
```

Terminal architecture (for instance Alpha, x86)

Specified By:

getTerminalArchitecture() in interface [org.iso.mpeg.mpegj.resource.StaticCapability](#)

Returns:

the terminal architecture type.

getTerminalLoad()

```
public long getTerminalLoad()
```

Terminal CPU Load

Specified By:

getTerminalLoad() in interface [org.iso.mpeg.mpegj.resource.DynamicCapability](#)

Returns:

the load (percentage) of the terminal CPUs

getTotalApplicationMemory()

public long getTotalApplicationMemory()

Total application memory (RAM)

Specified By:

getTotalApplicationMemory() in interface org.iso.mpeg.mpeqj.resource.DynamicCapability

Returns:

the total amount of memory (bytes).

getTotalTerminalMemory()

public long getTotalTerminalMemory()

Terminal total memory (RAM)

Specified By:

getTotalTerminalMemory() in interface org.iso.mpeg.mpeqj.resource.DynamicCapability

Returns:

the total amount of memory (bytes) installed on the terminal.

getVideoDrivers()

public java.lang.String[] getVideoDrivers()

Terminal Video Enc/Dec

Specified By:

getVideoDrivers() in interface org.iso.mpeg.mpeqj.resource.StaticCapability

Returns:

the available video drivers.

getVisualProfile()

public short getVisualProfile()

Specified By:

getVisualProfile() in interface org.iso.mpeg.mpeqj.resource.TerminalProfileManager

notifyApplicationFreeMemory(long, Observer)

public void notifyApplicationFreeMemory(long, java.util.Observer)

notifyApplicationFreeMemory

Specified By:

notifyApplicationFreeMemory(long, Observer) in interface

org.iso.mpeg.mpeqj.resource.DynamicCapabilityObserver

Parameters:

freeApplicationMemory - application memory threshold

objToNotify - object to notify when the specified threshold is exceeded

Throws:

IllegalArgumentException - the freeApplicationMemory is either negative or out of range.

notifyTerminalFreeMemory(long, Observer)

public void notifyTerminalFreeMemory(long, java.util.Observer)

notifyTerminalFreeMemory

Specified By:

notifyTerminalFreeMemory(long, Observer) in interface

org.iso.mpeg.mpeqj.resource.DynamicCapabilityObserver

Parameters:

freeTerminalMemory - terminal memory threshold

objToNotify - object to notify when the specified threshold is exceeded

Throws:

IllegalArgumentException - the freeTerminalMemory is either negative or out of range.

notifyTerminalLoad(long, Observer)

public void notifyTerminalLoad(long, java.util.Observer)

notifyTerminalLoad

Specified By:

notifyTerminalLoad(long, Observer) in interface org.iso.mpeg.mpegj.resource.DynamicCapabilityObserver

Parameters:

cpuLoadPercentage - terminal CPU load percentage threshold

objToNotify - object to notify when the specified threshold is exceeded

Throws:

IllegalArgumentException - the cpuLoadPercentage is either negative or out of range.

notifyTerminalNetworkLoad(long, Observer)

public void notifyTerminalNetworkLoad(long, java.util.Observer)

notifyTerminalNetworkLoad

Specified By:

notifyTerminalNetworkLoad(long, Observer) in interface org.iso.mpeg.mpegj.resource.DynamicCapabilityObserver

Parameters:

nwLoadPercentage - network load percentage threshold

objToNotify - object to notify when the specified threshold is exceeded

Throws:

IllegalArgumentException - the nwLoadPercentage is either negative or out of range.

V.2.4 org.iso.mpeg.mpegj.resource.CapabilityManagerNotFoundException**V.2.4.1 Syntax**

```
public class CapabilityManagerNotFoundException extends
    org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.resource.CapabilityManagerNotFoundException
```

All Implemented Interfaces:

java.io.Serializable

V.2.4.2 Description

The class CapabilityManagerNotFoundException is a subclass of MPEGJException. This Exception is thrown by the method getCapabilityManager() of Resource Manager.

| Member Summary | |
|----------------|--|
| Constructors | <u>CapabilityManagerNotFoundException()</u> <u>CapabilityManagerNotFoundException(String)</u> |

V.2.4.3 Constructors**CapabilityManagerNotFoundException()**

public CapabilityManagerNotFoundException()

Constructs an CapabilityManagerNotFoundException with no specified detail message.

CapabilityManagerNotFoundException(String)

```
public CapabilityManagerNotFoundException(java.lang.String)
```

Constructs an CapabilityManagerFoundException with a detailed message.

V.2.5 org.iso.mpeg.mpegj.resource.CapabilityObserver**V.2.5.1 Syntax**

```
public class CapabilityObserver extends java.util.Observable implements
    java.lang.Runnable

java.lang.Object
|
+--java.util.Observable
|
+--org.iso.mpeg.mpegj.resource.CapabilityObserver
```

All Implemented Interfaces:

java.lang.Runnable

V.2.5.2 Description

This class is used to store information related to dynamic observers.

| Member Summary | |
|-----------------------|---|
| Constructors | <u>CapabilityObserver(CapabilityManager, short)</u> |
| Methods | |
| void | <u>addObserver(Observer, long, boolean)</u> |
| void | <u>deleteObserver(Observer)</u> |
| void | <u>deleteObservers()</u> |
| void | <u>run()</u> |

V.2.5.3 Constructors**CapabilityObserver(CapabilityManager, short)**

```
public CapabilityObserver(org.iso.mpeg.mpegj.resource.CapabilityManager, short)
```

CapabilityObserver constructor

Parameters:

t - a reference to the CapabilityManager

_capabilityCode - objToDeregister the object to be deregistered.

V.2.5.4 Methods**addObserver(Observer, long, boolean)**

```
public synchronized void addObserver(java.util.Observer, long, boolean)
```

Add a new observer

Parameters:

o - the Observer

_threshold - the threshold value

deleteObserver(Observer)

```
public synchronized void deleteObserver(java.util.Observer)
```

deleteObserver: overrided method

Overrides:

java.util.Observable.deleteObserver(java.util.Observer) in class java.util.Observable

Parameters:

- o - the Observer

deleteObservers()

```
public synchronized void deleteObservers()
```

deleteObservers: overridden method

Overrides:

java.util.Observable.deleteObservers() in class java.util.Observable

Parameters:

- o - the Observer

run()

```
public void run()
```

run: the run() method (called by Thread)

Specified By:

java.lang.Runnable.run() in interface java.lang.Runnable

V.2.6 org.iso.mpeg.mpegj.resource.CPUMonitor**V.2.6.1 Syntax**

```
public class CPUMonitor extends java.lang.Object
    java.lang.Object
        |
        +-org.iso.mpeg.mpegj.resource.CPUMonitor
```

V.2.6.2 Description

The CPUMonitor class is used to monitor selected terminal activities including CPU load, and free/available system memory utilisation.

| Member Summary | |
|-----------------------|--|
| Constructors | |
| | CPUMonitor() |
| Methods | |
| short | getCPULoad() |
| long | getFreeSystemMemory() |
| long | getAvailSystemMemory() |

V.2.6.3 Constructors**CPUMonitor()**

```
public CPUMonitor()
```

V.2.6.4 Methods**getAvailSystemMemory()**

```
public static native long getAvailSystemMemory()
```

getCPULoad()

```
public static native short getCPULoad()
```

getFreeSystemMemory()

```
public static native long getFreeSystemMemory()
```

V.2.7 org.iso.mpeg.mpegj.resource.Dimension**V.2.7.1 Syntax**

```
public interface Dimension
```

V.2.7.2 Description

Interface for Dimension with set and get methods for Width and Height

| Member Summary | |
|-----------------------|-----------------------|
| Methods | |
| int | <u>getHeight()</u> |
| int | <u>getWidth()</u> |
| int | <u>setHeight(int)</u> |
| int | <u>setWidth(int)</u> |

V.2.7.3 Methods

getHeight()

public int getHeight()

Returns Height as an integer

getWidth()

public int getWidth()

Returns Width as an integer

setHeight(int)

public int setHeight(int)

Sets the Height to the specified value

setWidth(int)

public int setWidth(int)

Sets the Width to the specified value

V.2.8 org.iso.mpeg.mpegj.resource.DynamicCapability

V.2.8.1 Syntax

```
public interface DynamicCapability
```

All Known Implementing Classes:

[org.iso.mpeg.mpegj.resource.CapabilityManager](#)

V.2.8.2 Description

This interface is used to provide developers a simple way to access basic dynamic terminal capabilities. A capability is dynamic if it can change value/status at runtime. For instance memory usage is a dynamic capability.

| Member Summary | |
|-----------------------|------------------------------------|
| Methods | |
| long | <u>getFreeTerminalMemory()</u> |
| long | <u>getTotalTerminalMemory()</u> |
| long | <u>getTotalApplicationMemory()</u> |
| long | <u>getFreeApplicationMemory()</u> |
| long | <u>getTerminalLoad()</u> |
| long | <u>getNetworkLoad()</u> |

V.2.8.3 Methods

getFreeApplicationMemory()

public long getFreeApplicationMemory()

Free application memory (RAM)

Returns:

the amount of available (at application level e.g. JavaVM) free memory (bytes).

getFreeTerminalMemory()

public long getFreeTerminalMemory()

Terminal free memory (RAM)

Returns:

the amount of free memory (bytes) installed on the terminal.

getNetworkLoad()

```
public long getNetworkLoad()
```

Terminal Network Load

Returns:

the network load (percentage).

getTerminalLoad()

```
public long getTerminalLoad()
```

Terminal CPU Load

Returns:

the load (percentage) of the terminal CPUs

getTotalApplicationMemory()

```
public long getTotalApplicationMemory()
```

Total application memory (RAM)

Returns:

the total amount of memory (bytes).

getTotalTerminalMemory()

```
public long getTotalTerminalMemory()
```

Terminal total memory (RAM)

Returns:

the total amount of memory (bytes) installed on the terminal.

V.2.9 org.iso.mpeg.mpegj.resource.DynamicCapabilityObserver

V.2.9.1 Syntax

```
public interface DynamicCapabilityObserver
```

All Known Implementing Classes:

[org.iso.mpeg.mpegj.resource.CapabilityManager](#)

V.2.9.2 Description

Interface to observe Dynamic capabilities. This interface is used to be notified of varying capabilities.

| Member Summary | |
|----------------|--|
| Methods | <pre>void notifyApplicationFreeMemory(long, Observer) void notifyTerminalFreeMemory(long, Observer) void notifyTerminalLoad(long, Observer) void notifyTerminalNetworkLoad(long, Observer) void deleteObserver(Observer)</pre> |

V.2.9.3 Methods

deleteObserver(Observer)

```
public void deleteObserver(java.util.Observer)
```

This method is used to deregister an observer previously registered using any of the notifyXXX methods.

Parameters:

objToDeregister - the object to be deregistered.

notifyApplicationFreeMemory(long, Observer)

```
public void notifyApplicationFreeMemory(long, java.util.Observer)
```

This method is used by AVSession objects that want to be notified when the application free memory goes below a certain threshold.

Parameters:

freeApplicationMemory - the free application memory threshold (bytes).
objToNotify - the object to be notified.

Throws:

IllegalArgumentException - the threshold is out of range.

notifyTerminalFreeMemory(long, Observer)

public void notifyTerminalFreeMemory(long, java.util.Observer)

This method is used by AVSession objects that want to be notified when the total terminal free memory goes below a certain threshold.

Parameters:

freeTerminalMemory - the free application memory threshold (bytes).
objToNotify - the object to be notified.

Throws:

IllegalArgumentException - the threshold is out of range.

notifyTerminalLoad(long, Observer)

public void notifyTerminalLoad(long, java.util.Observer)

This method is used by AVSession objects that want to be notified when the terminal CPU load goes above a certain percentage.

Parameters:

cpuLoadPercentage - the cpu load (percentage) threshold.
objToNotify - the object to be notified.

Throws:

IllegalArgumentException - the threshold out of range [0...100].

notifyTerminalNetworkLoad(long, Observer)

public void notifyTerminalNetworkLoad(long, java.util.Observer)

This method is used by AVSession objects that want to be notified when the terminal network load goes above a certain percentage.

Parameters:

nwLoadPercentage - the network load (percentage) threshold.
objToNotify - the object to be notified.

Throws:

IllegalArgumentException - the threshold out of range [0...100].

V.2.10 org.iso.mpeg.mpegj.resource.IllegalDecoderMediaEventsException

V.2.10.1 Syntax

```
public class IllegalDecoderMediaEventsException extends  
    org.iso.mpeg.mpegj.MPEGJException  
  
java.lang.Object  
|  
+--java.lang.Throwable  
|  
+--java.lang.Exception  
|  
+--org.iso.mpeg.mpegj.MPEGJException  
|  
+--org.iso.mpeg.mpegj.resource.IllegalDecoderMediaEventsException
```

All Implemented Interfaces:

java.io.Serializable

V.2.10.2 Description

| Member Summary | |
|-----------------------|--|
| Constructors | <u>IllegalDecoderMediaEventsException()</u> <u>IllegalDecoderMediaEventsException(String)</u> |

V.2.10.3 Constructors

IllegalDecoderMediaEventsException()

public IllegalDecoderMediaEventsException()

Constructs an IllegalDecoderMediaEventsException with no specified detail message.

IllegalDecoderMediaEventsException(String)

public IllegalDecoderMediaEventsException(java.lang.String)

Constructs an IllegalDecoderMediaEventsException with a detailed message.

V.2.11 org.iso.mpeg.mpegj.resource.IllegalRendererMediaEventsException

V.2.11.1 Syntax

```
public class IllegalRendererMediaEventsException extends
    org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.resource.IllegalRendererMediaEventsException
```

All Implemented Interfaces:

java.io.Serializable

V.2.11.2 Description

This a subclass of MPEGJException. This is thrown when an illegal Renderer Media Event is posted

| Member Summary | |
|-----------------------|--|
| Constructors | <u>IllegalRendererMediaEventsException()</u> <u>IllegalRendererMediaEventsException(String)</u> |

V.2.11.3 Constructors

IllegalRendererMediaEventsException()

public IllegalRendererMediaEventsException()

Constructs an IllegalRendererMediaEventsException with no specified detail message.

IllegalRendererMediaEventsException(String)

public IllegalRendererMediaEventsException(java.lang.String)

Constructs an IllegalRendererMediaEventsException with a detailed message.

V.2.12 org.iso.mpeg.mpegj.resource.IllegalStreamMediaEventsException**V.2.12.1 Syntax**

```

public class IllegalStreamMediaEventsException extends
    org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.resource.IllegalStreamMediaEventsException

```

All Implemented Interfaces:

java.io.Serializable

V.2.12.2 Description

| Member Summary | |
|----------------|--|
| Constructors | <u>IllegalStreamMediaEventsException()</u> |

V.2.12.3 Constructors**IllegalStreamMediaEventsException()**public **IllegalStreamMediaEventsException()****V.2.13 org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator****V.2.13.1 Syntax**

public interface MPDecoderEventGenerator

All Known Subinterfaces:org.iso.mpeg.mpegj.decoder.MPDecoder**All Known Implementing Classes:**org.iso.mpeg.mpegj.resource.MPDecoderEventGeneratorImp**V.2.13.2 Description**

An interface for adding and removing Decoder event listeners.

| Member Summary | |
|----------------|---|
| Methods | |
| void | <u>addMPDecoderMediaListener(MPDecoderMediaListener)</u> |
| void | <u>removeMPDecoderMediaListener(MPDecoderMediaListener)</u> |

V.2.13.3 Methods**addMPDecoderMediaListener(MPDecoderMediaListener)**public void addMPDecoderMediaListener(org.iso.mpeg.mpegj.resource.MPDecoderMediaListener)

Add a Render event listener. The listener is called by an MPdecoder when registered.

Parameters:

1 - the listener to add.

removeMPDecoderMediaListener(MPDecoderMediaListener)

```
public void
removeMPDecoderMediaListener(org.iso.mpeg.mpegj.resource.MPDecoderMediaListener)
```

Remove a Decoder event listener.

Parameters:

1 - the listener to remove.

V.2.14 org.iso.mpeg.mpegj.resource.MPDecoderEventGeneratorImp**V.2.14.1 Syntax**

```
public class MPDecoderEventGeneratorImp extends java.lang.Object implements
org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator

java.lang.Object
|
+--org.iso.mpeg.mpegj.resource.MPDecoderEventGeneratorImp
```

All Implemented Interfaces:

[org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator](#)

V.2.14.2 Description

An interface for adding and removing Decoder event listeners.

| Member Summary | |
|-----------------------|---|
| Constructors | MPDecoderEventGeneratorImp() |
| Methods | void addMPDecoderMediaListener(MPDecoderMediaListener) void removeMPDecoderMediaListener(MPDecoderMediaListener) |

V.2.14.3 Constructors**MPDecoderEventGeneratorImp()**

```
public MPDecoderEventGeneratorImp()
```

V.2.14.4 Methods**addMPDecoderMediaListener(MPDecoderMediaListener)**

```
public void
addMPDecoderMediaListener(org.iso.mpeg.mpegj.resource.MPDecoderMediaListener)
```

Add a Render event listener. The listener is called by an MPdecoder when registered.

Specified By:

[addMPDecoderMediaListener\(MPDecoderMediaListener\)](#) in interface
[org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator](#)

Parameters:

1 - the listener to add.

removeMPDecoderMediaListener(MPDecoderMediaListener)

```
public void
removeMPDecoderMediaListener(org.iso.mpeg.mpegj.resource.MPDecoderMediaListener)
```

Remove a Decoder event listener.

Specified By:

[removeMPDecoderMediaListener\(MPDecoderMediaListener\)](#) in interface
[org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator](#)

Parameters:

1 - the listener to remove.

V.2.15 org.iso.mpeg.mpegj.resource.MPDecoderMediaEvents**V.2.15.1 Syntax**

```
public class MPDecoderMediaEvents extends java.util.EventObject
    java.lang.Object
    |
    +--java.util.EventObject
    |
    +--org.iso.mpeg.mpegj.resource.MPDecoderMediaEvents
```

All Implemented Interfaces:

java.io.Serializable

V.2.15.2 Description

An event object that is given to an MPDecoderMediaListener.

| Member Summary | |
|--|---------------------------|
| Fields | |
| int | <u>DECODER_OVERFLOW</u> |
| int | <u>DECODER_SYNC_ERROR</u> |
| int | <u>STREAM_UNDERFLOW</u> |
| int | <u>STREAM_OVERFLOW</u> |
| int | <u>STREAM_START</u> |
| int | <u>STREAM_END</u> |
| Constructors | |
| <u>MPDecoderMediaEvents(Object, int)</u> | |
| Methods | |
| int | <u>getCondition()</u> |

V.2.15.3 Fields**DECODER_OVERFLOW**

```
public static final int DECODER_OVERFLOW
```

```
DECODER_OVERFLOW = 0
```

DECODER_SYNC_ERROR

```
public static final int DECODER_SYNC_ERROR
```

```
DECODER_SYNC_ERROR = 1
```

STREAM_END

```
public static final int STREAM_END
```

```
STREAM_END = 5
```

STREAM_OVERFLOW

```
public static final int STREAM_OVERFLOW
```

```
STREAM_OVERFLOW = 3
```

STREAM_START

```
public static final int STREAM_START
```

```
STREAM_START = 4
```

STREAM_UNDERFLOW

```
public static final int STREAM_UNDERFLOW
```

```
STREAM_UNDERFLOW = 2
```

V.2.15.4 Constructors**MPDecoderMediaEvents(Object, int)**

```
public MPDecoderMediaEvents(java.lang.Object, int)
```

Construct an event object with condition. condition can be decoder overflow, sync error, or end of decode, otherwise throws exception

Parameters:

source - the source of the event

condition - The condition variable can correspond the to decoder overflow, sync error, stream start or stop

Throws:

[org.iso.mpeg.mpegj.resource.IllegalDecoderMediaEventsException](#) - thrown an Illegal Decoder Event is thrown

V.2.15.5 Methods

getCondition()

public int getCondition()

The obtained condition can correspond to decoder overflow, sync error, stream underflow, stream overflow, stream start or stream end

V.2.16 org.iso.mpeg.mpegj.resource.MPDecoderMediaListener

V.2.16.1 Syntax

```
public interface MPDecoderMediaListener extends java.util.EventListener
```

All Superinterfaces:

java.util.EventListener

V.2.16.2 Description

An interface that is called by an MPDecoder when registered.

See Also:

[org.iso.mpeg.mpegj.resource.MPDecoderEventGenerator](#)

| Member Summary | |
|-----------------------|--|
| Methods | |
| void | <u>mPDecoderMediaHandler(MPDecoderMediaEvents)</u> |

V.2.16.3 Methods

mPDecoderMediaHandler(MPDecoderMediaEvents)

public void mPDecoderMediaHandler([org.iso.mpeg.mpegj.resource.MPDecoderMediaEvents](#))

Notification of a Renderer event, called by a MPDecoder during decoder overflow, sync error, stream start or stop.

Parameters:

event - refers to the source of the event.

V.2.17 org.iso.mpeg.mpegj.resource.MPRendererEventGenerator

V.2.17.1 Syntax

```
public interface MPRendererEventGenerator
```

All Known Subinterfaces:

[org.iso.mpeg.mpegj.resource.Renderer](#)

V.2.17.2 Description

An interface for adding and removing Renderer event listeners.

| Member Summary | |
|-----------------------|---|
| Methods | |
| void | <u>addMPRendererMediaListener(MPRendererMediaListener)</u> |
| void | <u>removeMPRendererMediaListener(MPRendererMediaListener)</u> |

V.2.17.3 Methods

addMPRendererMediaListener(MPRendererMediaListener)

```
public void
addMPRendererMediaListener(org.iso.mpeg.mpegj.resource.MPRendererMediaListener)
```

Add a Renderer event listener. The listener is called by the renderer when registered.

Parameters:

l - the listener to add.

removeMPRendererMediaListener(MPRendererMediaListener)

```
public void
removeMPRendererMediaListener(org.iso.mpeg.mpegj.resource.MPRendererMediaListener)
```

Remove a Renderer event listener.

Parameters:

l - the listener to remove.

V.2.18 org.iso.mpeg.mpegj.resource.MPRendererFrameEventGenerator

V.2.18.1 Syntax

```
public interface MPRendererFrameEventGenerator
```

All Known Subinterfaces:

[org.iso.mpeg.mpegj.resource.Renderer](#)

V.2.18.2 Description

An interface for adding and removing frame event listeners.

| Member Summary | |
|-----------------------|---|
| Methods | |
| void | <u>addMPRendererFrameListener(MPRendererFrameListener, int)</u> |
| void | <u>removeMPRendererFrameListener(MPRendererFrameListener)</u> |

V.2.18.3 Methods

addMPRendererFrameListener(MPRendererFrameListener, int)

```
public void
addMPRendererFrameListener(org.iso.mpeg.mpegj.resource.MPRendererFrameListener, int)
```

Add a frame event listener. The listener is called periodically by the renderer. The frames parameter indicates the number of frames between each callback.

Parameters:

l - the listener to add.

frames - the number of frames between each callback.

removeMPRendererFrameListener(MPRendererFrameListener)

```
public void
removeMPRendererFrameListener(org.iso.mpeg.mpegj.resource.MPRendererFrameListener)
```

Remove a frame event listener.

Parameters:

l - the listener to remove.

V.2.19 org.iso.mpeg.mpeej.resource.MPRendererFrameEvents**V.2.19.1 Syntax**

```
public class MPRendererFrameEvents extends java.util.EventObject
    java.lang.Object
    |
    +-java.util.EventObject
    |
    +-org.iso.mpeg.mpeej.resource.MPRendererFrameEvents
```

All Implemented Interfaces:

java.io.Serializable

V.2.19.2 Description

An event object that is given to an MPRendererFrameListener.

| Member Summary | |
|-----------------------|---|
| Constructors | MPRendererFrameEvents(Object) |

V.2.19.3 Constructors**MPRendererFrameEvents(Object)**

```
public MPRendererFrameEvents(java.lang.Object)
```

Construct a frame event object with a source.

Parameters:

source - the source of the event.

V.2.20 org.iso.mpeg.mpeej.resource.MPRendererFrameListener**V.2.20.1 Syntax**

```
public interface MPRendererFrameListener
```

V.2.20.2 Description

An interface that is called periodically by the renderer. The number of frames between each call is specified when the listener is registered.

See Also:

[org.iso.mpeej.resource.MPRendererFrameEventGenerator](#)

| Member Summary | |
|-----------------------|--|
| Methods | void frameEvent(MPRendererFrameEvents) |

V.2.20.3 Methods**frameEvent(MPRendererFrameEvents)**

```
public void frameEvent(org.iso.mpeej.resource.MPRendererFrameEvents)
```

Notification of a frame event, called periodically by the renderer.

Parameters:

event - refers to the source of the event.

V.2.21 org.iso.mpeg.mpegj.resource.MPRendererMediaEvents**V.2.21.1 Syntax**

```
public class MPRendererMediaEvents extends java.util.EventObject
    java.lang.Object
    |
    +--java.util.EventObject
    |
    +--org.iso.mpeg.mpegj.resource.MPRendererMediaEvents
```

All Implemented Interfaces:

java.io.Serializable

V.2.21.2 Description

An event object that is given to an MPRendererMediaListener.

| Member Summary | |
|---|--------------------------|
| Fields | |
| int | <u>DECODER_UNDERFLOW</u> |
| int | <u>MISSED_FRAMES</u> |
| Constructors | |
| <u>MPRendererMediaEvents(Object, int)</u> | |
| Methods | |
| int | <u>getCondition()</u> |

V.2.21.3 Fields**DECODER_UNDERFLOW**

public static final int DECODER_UNDERFLOW

DECODER_UNDERFLOW = 0

MISSED_FRAMES

public static final int MISSED_FRAMES

MISSED_FRAMES = 1

V.2.21.4 Constructors**MPRendererMediaEvents(Object, int)**

public MPRendererMediaEvents(java.lang.Object, int)

Construct an event object with condition. condition can be decoder underflow or missed frames

Parameters:

source - the source of the event

condition - The condition variable can correspond the to decoder underflow or missed frame.

Throws:org.iso.mpeg.mpegj.resource.IllegalRendererMediaEventsException - thrown an Illegal Renderer Event is thrown**V.2.21.5 Methods****getCondition()**

public int getCondition()

Gets the Condition. The obtained condition can correspond to decoder underflow or a missed frame.

V.2.22 org.iso.mpeg.mpegj.resource.MPRendererMediaListener**V.2.22.1 Syntax**

```
public interface MPRendererMediaListener extends java.util.EventListener
```

All Superinterfaces:

java.util.EventListener

V.2.22.2 Description

An interface that is called by the renderer when registered.

See Also:

[org.iso.mpeg.mpegj.resource.MPRendererEventGenerator](#)

| Member Summary | |
|-----------------------|--|
| Methods | |
| void | mPCompositeMediaHandler(MPRendererMediaEvents) |

V.2.22.3 Methods**mPCompositeMediaHandler(MPRendererMediaEvents)**

```
public void mPCompositeMediaHandler(org.iso.mpeg.mpegj.resource.MPRendererMediaEvents)
```

Notification of a Renderer event, called by the renderer during decoder underflow or a missed frame.

Parameters:

event - refers to the source of the event.

V.2.23 org.iso.mpeg.mpegj.resource.Renderer**V.2.23.1 Syntax**

```
public interface Renderer extends
org.iso.mpeg.mpegj.resource.MPRendererEventGenerator,
org.iso.mpeg.mpegj.resource.MPRendererFrameEventGenerator
```

All Superinterfaces:

[org.iso.mpeg.mpegj.resource.MPRendererEventGenerator](#),
[org.iso.mpeg.mpegj.resource.MPRendererFrameEventGenerator](#)

V.2.23.2 Description

Interface for the Rendering Engine.

V.2.24 org.iso.mpeg.mpegj.resource.RendererNotFoundException**V.2.24.1 Syntax**

```
public class RendererNotFoundException extends org.iso.mpeg.mpegj.MPEGJException
```

java.lang.Object

|

+--java.lang.Throwable

|

+--java.lang.Exception

|

+--[org.iso.mpeg.mpegj.MPEGJException](#)

|

+--[org.iso.mpeg.mpegj.resource.RendererNotFoundException](#)

All Implemented Interfaces:

java.io.Serializable

V.2.24.2 Description

The class RendererNotFoundException is a subclass of MPEGJException. This Exception is thrown by the method getRenderer() of Resource Manager.

| Member Summary | |
|-----------------------|---|
| Constructors | |
| | RendererNotFoundException() |
| | RendererNotFoundException(String) |

V.2.24.3 Constructors**RendererNotFoundException()**

public RendererNotFoundException()

Constructs an RendererNotFoundException with no specified detail message.

RendererNotFoundException(String)

public RendererNotFoundException(java.lang.String)

Constructs an RendererNotFoundException with a detailed message.

V.2.25 org.iso.mpeg.mpegj.resource.ResourceManager**V.2.25.1 Syntax**

```
public class ResourceManager extends java.lang.Object
    java.lang.Object
        |
        +--org.iso.mpeg.mpegj.resource.ResourceManager
```

V.2.25.2 Description

The resource manager is used for regulation of performance. The Resource Manager API provides a centralized facility for managing resources. It is a collection of a number of classes and interfaces summarized as follows.

| Member Summary | |
|-----------------------|--|
| Constructors | ResourceManager() |
| Methods | |
| CapabilityManager | getCapabilityManager() |
| void | setDecPriority(MPDecoder, int) |
| int | getDecPriority(MPDecoder) |
| MPDecoder | getDecoder(ObjectDescriptor, ESDescriptor) |
| Renderer | getRenderer() |
| void | changeDecoder(ObjectDescriptor, ESDescriptor, MPDecoder) |
| MPDecoder[] | getAvailableDecoder(DecoderType) |

V.2.25.3 Constructors**ResourceManager()**

public ResourceManager()

V.2.25.4 Methods**changeDecoder(ObjectDescriptor, ESDescriptor, MPDecoder)**public void changeDecoder([org.iso.mpeg.mpegj.ObjectDescriptor](#),
[org.iso.mpeg.mpegj.ESDescriptor](#), [org.iso.mpeg.mpegj.decoder.MPDecoder](#))

Change decoder on the given Object Descriptor and ESDescriptor. The underlying implementation is expected to instantiate, attach and start a decoder similar to establishing a new decoder for a BIFS node. All the elementary streams attached to the original decoder is attached to the new decoder.

Throws:

`org.iso.mpeg.mpeqj.decoder.DecoderNotFoundException` - Thrown when the Decoder is not available
`org.iso.mpeg.mpeqj.scene.BadNodeException` - is thrown when the OD does not correspond to a valid node in the scenegraph

getAvailableDecoder(DecoderType)

```
public org.iso.mpeg.mpeqj.decoder.MPDecoder
getAvailableDecoder(org.iso.mpeg.mpeqj.decoder.DecoderType)
```

Get available decoders given decoder type.

Returns:

returns an array of available decoders that are not used currently.

Throws:

`org.iso.mpeg.mpeqj.decoder.InvalidDecoderTypeException` - Thrown when the DecoderType not valid

getCapabilityManager()

```
public org.iso.mpeg.mpeqj.resource.CapabilityManager getCapabilityManager()
```

Returns the CapabilityManager used to retrieve all the capabilities (static, dynamic, profile) of the terminal.

Returns:

the CapabilityManager if available

Throws:

`org.iso.mpeg.mpeqj.resource.CapabilityManagerNotFoundException` - Thrown when the CapabilityManager is not available (e.g. it is impossible to retrieve information about CPU load, memory etc.)

getDecoder(ObjectDescriptor, ESDescriptor)

```
public org.iso.mpeg.mpeqj.decoder.MPDecoder
getDecoder(org.iso.mpeg.mpeqj.ObjectDescriptor, org.iso.mpeg.mpeqj.ESDescriptor)
```

Get Decoder for the given ObjectDescriptor and ESDescriptor.

Throws:

`org.iso.mpeg.mpeqj.decoder.DecoderNotFoundException` - Thrown when the Decoder is not available
`org.iso.mpeg.mpeqj.scene.BadNodeException` - is thrown when the nodeId does not correspond to a valid node in the scenegraph

getDecPriority(MPDecoder)

```
public int getDecPriority(org.iso.mpeg.mpeqj.decoder.MPDecoder)
```

Get priority of a media elementary stream.

Throws:

`org.iso.mpeg.mpeqj.decoder.DecoderNotFoundException` - Thrown when the Decoder is not available

getRenderer()

```
public org.iso.mpeg.mpeqj.resource.Renderer getRenderer()
```

Get renderer and be ready to add events to renderer.

Throws:

`org.iso.mpeg.mpeqj.resource.RendererNotFoundException` - is thrown if the Renderer is not available

setDecPriority(MPDecoder, int)

```
public void setDecPriority(org.iso.mpeg.mpeqj.decoder.MPDecoder, int)
```

Override/change priority of a media elementary stream.

Throws:

`org.iso.mpeg.mpeqj.decoder.DecoderNotFoundException` - Thrown when the Decoder is not available

`org.iso.mpeg.mpeqj.decoder.InvalidDecoderPriorityException` - thrown when the priority is invalid

V.2.26 org.iso.mpeg.mpeqj.resource.ResourceManagerNotFoundException**V.2.26.1 Syntax**

```
public class ResourceManagerNotFoundException extends
    org.iso.mpeg.mpeqj.MPEGJException
```

```

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.resource.ResourceManagerNotFoundException

```

All Implemented Interfaces:

java.io.Serializable

V.2.26.2 Description

The class ResourceManagerNotFoundException is a subclass of MPEGJException. This Exception is thrown by the method getRM() of MpegjTerminal.

| Member Summary | |
|----------------|--|
| Constructors | |
| | <u>ResourceManagerNotFoundException()</u> <u>ResourceManagerNotFoundException(String)</u> |

V.2.26.3 Constructors**ResourceManagerNotFoundException()**

public ResourceManagerNotFoundException()

Constructs an ResourceManagerNotFoundException with no specified detail message.

ResourceManagerNotFoundException(String)

public ResourceManagerNotFoundException(java.lang.String)

Constructs an ResourceManagerNotFoundException with a detailed message.

V.2.27 org.iso.mpeg.mpegj.resource.StaticCapability**V.2.27.1 Syntax**

public interface StaticCapability

All Known Implementing Classes:org.iso.mpeg.mpegj.resource.CapabilityManager**V.2.27.2 Description**

This interface is used to provide developers a simple way to access basic dynamic terminal capabilities. A capability is considered static if its value cannot change at runtime. For instance the audio card type is a static capability.

| Member Summary | |
|----------------|-------------------------------|
| Methods | |
| int | <u>getNumCPUs()</u> |
| int | <u>getCPUSpeed(int)</u> |
| String | <u>getCPUType(int)</u> |
| String | <u>getMouseType()</u> |
| int | <u>getDisplayColorDepth()</u> |
| String | <u>getDisplayType()</u> |
| String | <u>getKeyboardType()</u> |
| String | <u>getNetworkType()</u> |
| int | <u>getNumParallelPorts()</u> |
| int | <u>getNumSerialPorts()</u> |

| | |
|-----------|----------------------------------|
| Dimension | <u>getScreenSize()</u> |
| short | <u>getScreenDepth()</u> |
| short | <u>getScreenResolution()</u> |
| String | <u>getOSLanguage()</u> |
| String | <u>getOSType()</u> |
| String | <u>getTerminalArchitecture()</u> |
| String[] | <u>getAudioDrivers()</u> |
| String[] | <u>getMIDIDrivers()</u> |
| String[] | <u>getVideoDrivers()</u> |
| String | <u>getModemType()</u> |

V.2.27.3 Methods

getAudioDrivers()

public java.lang.String[] getAudioDrivers()

Terminal Audio Enc/Dec

Returns:

the available audio drivers.

getCPUSpeed(int)

public int getCPUSpeed(int)

Terminal CPU Speed

Parameters:

idx - the index of the video card (idx >= 0)

Returns:

the speed (Mhz) of a terminal CPU.

Throws:

IllegalArgumentException - the index is either negative or out of range.

getCPUType(int)

public java.lang.String getCPUType(int)

Terminal CPU type (Pentium for instance)

Parameters:

idx - the index of the CPU (idx >= 0)

Returns:

the type of CPU

Throws:

IllegalArgumentException - the index is either negative or out of range.

getDisplayColorDepth()

public int getDisplayColorDepth()

Terminal Display Color Depth

Returns:

the display color depth (bits per pixel)

getDisplayType()

public java.lang.String getDisplayType()

Terminal Display Type (e.g. VGA)

Returns:

the display type

getKeyboardType()

public java.lang.String getKeyboardType()

Terminal Keyboard Type

Returns:

the keyboard type, NULL if the keyboard is not present.

getMIDIDrivers()

public java.lang.String[] getMIDIDrivers()

Terminal MIDI Enc/Dec

Returns:

the available MIDI drivers.

getModemType()

public java.lang.String getModemType()

Terminal modem type [IsInternalModem]

Returns:

the modem speed ("28K", "56K" etc.) or NULL is the modem is not installed.

getMouseType()

public java.lang.String getMouseType()

Terminal Mouse Type

Returns:

the mouse type

getNetworkType()

public java.lang.String getNetworkType()

Terminal Network Type

Returns:

the network type.

getNumCPUs()

public int getNumCPUs()

Number of Terminal CPUs

Returns:

the number of CPUs that equip the terminal

getNumParallelPorts()

public int getNumParallelPorts()

Terminal parallel IEEE-1284 port(s)

Returns:

the number of parallel ports present on the terminal.

getNumSerialPorts()

public int getNumSerialPorts()

Terminal serial RS-232 port(s)

Returns:

the number of serial ports present on the terminal.

getOSLanguage()

public java.lang.String getOSLanguage()

Terminal OS language [IsLanguage]

Returns:

the language of the OS version installed on the terminal.

getOSType()

public java.lang.String getOSType()

Terminal OS type (for instance JavaPC, Windows, MacOS) [IsOpSys/IsSysType]

Returns:

the OS type installed on the terminal.

getScreenDepth()

public short getScreenDepth()

Terminal screen depth

Returns:

the screen depth (bits/inch)

getScreenResolution()

```
public short getScreenResolution()
```

Terminal screen resolution

Returns:

the screen resolution (dots/inch)

getScreenSize()

```
public org.iso.mpeg.mpeqj.resource.Dimension getScreenSize()
```

Terminal screen size

Returns:

the screen size (pixel x pixel)

getTerminalArchitecture()

```
public java.lang.String getTerminalArchitecture()
```

Terminal architecture (for instance Alpha, x86)

Returns:

the terminal architecture type.

getVideoDrivers()

```
public java.lang.String[] getVideoDrivers()
```

Terminal Video Enc/Dec

Returns:

the available video drivers.

V.2.28 org.iso.mpeg.mpeqj.resource.TerminalProfileManager

V.2.28.1 Syntax

```
public interface TerminalProfileManager
```

All Known Implementing Classes:

org.iso.mpeg.mpeqj.resource.CapabilityManager

V.2.28.2 Description

This interface allows applications to query the terminal profiles. Profiles are specified in the document ISO/IEC 14496-1.

| Member Summary | |
|----------------|-------------------------------------|
| Methods | |
| short | <u>getVisualProfile()</u> |
| short | <u>getAudioProfile()</u> |
| short | <u>getSceneDescriptionProfile()</u> |
| short | <u>getODProfile()</u> |
| short | <u>getGraphicsProfile()</u> |
| short | <u>getMPEGJProfile()</u> |

V.2.28.3 Methods

getAudioProfile()

```
public short getAudioProfile()
```

This method returns the supported audio profile. The value of the return value is as given in audioProfileLevelIndication Table in ISO/ IEC 14496-1

Returns:

the audio description profile and level.

getGraphicsProfile()

```
public short getGraphicsProfile()
```

This method returns the supported scene description profile. The value of the return value is as given in graphicsProfileLevelIndication Table in ISO/IEC 14496-1

Returns:

the supported Graphics profile and level.

getMPEGJProfile()

```
public short getMPEGJProfile()
```

This method returns the supported scene description profile The value of the return value is as given in MPEG-JProfileLevelIndication Table in ISO/IEC 14496-1

Returns:

the supported MPEG-J profile and level.

getODProfile()

```
public short getODProfile()
```

This method returns the supported scene description profile The value of the return value is as given in ODProfileLevelIndication Table in ISO/IEC 14496-1

Returns:

the supported OD profile and level.

getSceneDescriptionProfile()

```
public short getSceneDescriptionProfile()
```

This method returns the supported scene description profile The value of the return value is as given in sceneProfileLevelIndication Table in ISO/IEC 14496-1

Returns:

the supported sceen description profile and level.

getVisualProfile()

```
public short getVisualProfile()
```

This method returns the supported visual profile The value of the return value is as given in visualProfileLevelIndication Table in ISO/ IEC 14496-1

Returns:

the supported visual profile and level.

V.3 package org.iso.mpeg.mpegj.decoder**V.3.1 Description**

| Class Summary | |
|--|---|
| Interfaces | |
| <u>MPDecoder</u> | This is the base interface for media decoders. |
| <u>DecoderType</u> | Interface for decoder types. |
| Exceptions | |
| <u>MediaDecoderException</u> | The class MediaDecoderException is a subclass of MPEGJException and is the parent of all ScenManagerExceptions. |
| <u>InvalidDecoderLevelException</u> | The class InvalidDecoderLevelException is a subclass of MediaDecoderException. |
| <u>DecoderNotFoundException</u> | The class DecoderNotFoundException is a subclass of MediaDecoderException. |
| <u>InvalidDecoderPriorityException</u> | The class InvalidDecoderPriorityException is a subclass of MediaDecoderException. |
| <u>InvalidDecoderSpeedException</u> | The class InvalidDecoderSpeedException is a subclass of MediaDecoderException. |
| <u>InvalidDecoderModeException</u> | The class InvalidDecoderModeException is a subclass of MediaDecoderException. |
| <u>DecoderNotRunningException</u> | The class DecoderNotRunningException is a subclass of MediaDecoderException. |
| <u>DecoderAlreadyAttachedException</u> | The class DecoderAlreadyAttachedException is a subclass of MediaDecoderException. |
| <u>DecoderNotAttachedException</u> | The class DecoderNotAttachedException is a subclass of MediaDecoderException. |
| <u>DecoderAlreadyRunningException</u> | The class DecoderAlreadyRunningException is a subclass of MediaDecoderException. |
| <u>InvalidDecoderTypeException</u> | The class InvalidDecoderTypeException is a subclass of MediaDecoderException. |

V.3.2 org.iso.mpeg.mpegj.decoder.DecoderAlreadyAttachedException

V.3.2.1 Syntax

```

public class DecoderAlreadyAttachedException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException
|
+--org.iso.mpeg.mpegj.decoder.DecoderAlreadyAttachedException

```

All Implemented Interfaces:

java.io.Serializable

V.3.2.2 Description

The class DecoderAlreadyAttachedException is a subclass of MediaDecoderException. This Exception is thrown when a Decoder that is already attached is attempted to attach again.

| Member Summary | |
|----------------|--|
| Constructors | |
| | <u>DecoderAlreadyAttachedException()</u> |
| | <u>DecoderAlreadyAttachedException(String)</u> |

V.3.2.3 Constructors

DecoderAlreadyAttachedException()

public DecoderAlreadyAttachedException()

Constructs an DecoderAlreadyAttachedException with no specified detail message.

DecoderAlreadyAttachedException(String)

public DecoderAlreadyAttachedException(java.lang.String)

Constructs an DecoderAttachedException with a detailed message.

V.3.3 org.iso.mpeg.mpegj.decoder.DecoderAlreadyRunningException

V.3.3.1 Syntax

```

public class DecoderAlreadyRunningException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException

```

java.lang.Object

|

+--java.lang.Throwable

|

+--java.lang.Exception

|

+--org.iso.mpeg.mpegj.MPEGJException

|

```
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException
  |
  +-org.iso.mpeg.mpegj.decoder.DecoderAlreadyRunningException
```

All Implemented Interfaces:

java.io.Serializable

V.3.3.2 Description

The class DecoderAlreadyRunningException is a subclass of MediaDecoderException. This Exception is thrown when a Decoder that is already running is attempted to start.

| Member Summary | |
|-----------------------|--|
| Constructors | |
| | DecoderAlreadyRunningException() |
| | DecoderAlreadyRunningException(String) |

V.3.3.3 Constructors**DecoderAlreadyRunningException()**

public DecoderAlreadyRunningException()

Constructs an DecoderAlreadyRunningException with no specified detail message.

DecoderAlreadyRunningException(String)

public DecoderAlreadyRunningException(java.lang.String)

Constructs an DecoderRunningException with a detailed message.

V.3.4 org.iso.mpeg.mpegj.decoder.DecoderNotAttachedException**V.3.4.1 Syntax**

```
public class DecoderNotAttachedException extends
  org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
  |
  +-java.lang.Throwable
    |
    +-java.lang.Exception
      |
      +-org.iso.mpeg.mpegj.MPEGJException
        |
        +-org.iso.mpeg.mpegj.decoder.MediaDecoderException
          |
          +-org.iso.mpeg.mpegj.decoder.DecoderNotAttachedException
```

All Implemented Interfaces:

java.io.Serializable

V.3.4.2 Description

The class DecoderNotAttachedException is a subclass of MediaDecoderException. This Exception is thrown when a Decoder that is not attached is attempted detach.

| Member Summary | |
|-----------------------|---|
| Constructors | |
| | DecoderNotAttachedException() |
| | DecoderNotAttachedException(String) |

V.3.4.3 Constructors

DecoderNotAttachedException()

```
public DecoderNotAttachedException()
```

Constructs an DecoderNotAttachedException with no specified detail message.

DecoderNotAttachedException(String)

```
public DecoderNotAttachedException(java.lang.String)
```

Constructs an DecoderAttachedException with a detailed message.

V.3.5 org.iso.mpeg.mpegj.decoder.DecoderNotFoundException

V.3.5.1 Syntax

```
public class DecoderNotFoundException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException
|
+--org.iso.mpeg.mpegj.decoder.DecoderNotFoundException
```

All Implemented Interfaces:

java.io.Serializable

V.3.5.2 Description

The class DecoderNotFoundException is a subclass of MediaDecoderException. This Exception is thrown by the method getDecoder() of ResourceManager.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>DecoderNotFoundException()</u> <u>DecoderNotFoundException(String)</u> |

V.3.5.3 Constructors

DecoderNotFoundException()

```
public DecoderNotFoundException()
```

Constructs an DecoderNotFoundException with no specified detail message.

DecoderNotFoundException(String)

```
public DecoderNotFoundException(java.lang.String)
```

Constructs an DecoderFoundException with a detailed message.

V.3.6 org.iso.mpeg.mpegj.decoder.DecoderNotRunningException

V.3.6.1 Syntax

```
public class DecoderNotRunningException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException
```

```

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException
|
+--org.iso.mpeg.mpegj.decoder.DecoderNotRunningException

```

All Implemented Interfaces:

java.io.Serializable

V.3.6.2 Description

The class DecoderNotRunningException is a subclass of MediaDecoderException. This Exception is thrown when a Decoder that is not running is attempted to pause or stop.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>DecoderNotRunningException()</u> <u>DecoderNotRunningException(String)</u> |

V.3.6.3 Constructors**DecoderNotRunningException()**

public DecoderNotRunningException()

Constructs an DecoderNotRunningException with no specified detail message.

DecoderNotRunningException(String)

public DecoderNotRunningException(java.lang.String)

Constructs an DecoderNotRunningException with a detailed message.

V.3.7 org.iso.mpeg.mpegj.decoder.DecoderType**V.3.7.1 Syntax**

public interface DecoderType

V.3.7.2 Description

Interface for decoder types.

| Member Summary | |
|-----------------------|--|
| Fields | int <u>MPEG1V</u> int <u>MPEG1A</u> int <u>MPEG2TS</u> int <u>MPEG2V</u> int <u>MPEG2A</u> int <u>MPEG4S</u> int <u>MPEG4V</u> int <u>MPEG4VS</u> int <u>MPEG4T</u> int <u>MPEG4TS</u> int <u>MPEG4M</u> int <u>MPEG4F</u> int <u>MPEG4FS</u> int <u>MPEG4A</u> |

| | | |
|----------------|-----|-------------------------|
| Methods | int | <u>MPEG4AS</u> |
| | int | <u>MPEG4TT</u> |
| | int | <u>MPEG4SA</u> |
| | int | <u>getDecoderType()</u> |

V.3.7.3 Fields

MPEG1A

public static final int MPEG1A
MPEG1 audio. MPEG1A = 1

MPEG1V

public static final int MPEG1V
MPEG1 video. MPEG1V = 0

MPEG2A

public static final int MPEG2A
MPEG2 audio. MPEG2A = 4

MPEG2TS

public static final int MPEG2TS
MPEG2 transport stream. MPEG2TS = 2

MPEG2V

public static final int MPEG2V
MPEG2 video. MPEG2V = 3

MPEG4A

public static final int MPEG4A
MPEG4 audio. MPEG4A = 13

MPEG4AS

public static final int MPEG4AS
MPEG4 scalable audio MPEG4AS = 14

MPEG4F

public static final int MPEG4F
MPEG4 face decoder. MPEG4F = 11

MPEG4FS

public static final int MPEG4FS
MPEG4 scalable face decoder. MPEG4FS = 12

MPEG4M

public static final int MPEG4M
MPEG4M = 10

MPEG4S

public static final int MPEG4S
MPEG4 systems. MPEG4S = 5

MPEG4SA

public static final int MPEG4SA
MPEG4 structured audio. MPEG4SA = 16

MPEG4T

public static final int MPEG4T
MPEG4 image texture. MPEG4T = 8

MPEG4TS

public static final int MPEG4TS
MPEG4 scalable texture. MPEG4TS = 9

MPEG4TT

public static final int MPEG4TT

MPEG4 TTS audio MPEG4TT = 15

MPEG4V

public static final int MPEG4V

MPEG4 video. MPEG4V = 6

MPEG4VS

public static final int MPEG4VS

MPEG4 scalable video. MPEG4VS = 7

V.3.7.4 Methods

getDecoderType()

public int getDecoderType()

Get decoder type.

V.3.8 org.iso.mpeg.mpegj.decoder.InvalidDecoderLevelException

V.3.8.1 Syntax

```
public class InvalidDecoderLevelException extends  
    org.iso.mpeg.mpegj.decoder.MediaDecoderException
```

java.lang.Object

```
|  
+--java.lang.Throwable  
|  
+--java.lang.Exception  
|  
+--org.iso.mpeg.mpegj.MPEGJException  
|  
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException  
|  
+--org.iso.mpeg.mpegj.decoder.InvalidDecoderLevelException
```

All Implemented Interfaces:

java.io.Serializable

V.3.8.2 Description

The class InvalidDecoderLevelException is a subclass of MediaDecoderException. This Exception is thrown by the when a decoder Level is attempted to be set to an invalid value (by the Media APIs).

| Member Summary | |
|----------------|--|
| Constructors | <u>InvalidDecoderLevelException()</u> <u>InvalidDecoderLevelException(String)</u> |

V.3.8.3 Constructors

InvalidDecoderLevelException()

public InvalidDecoderLevelException()

Constructs an InvalidDecoderLevelException with no specified detail message.

InvalidDecoderLevelException(String)

public InvalidDecoderLevelException(java.lang.String)

Constructs an InvalidDecoderLevelException with a detailed message.

V.3.9 org.iso.mpeg.mpegj.decoder.InvalidDecoderModeException

V.3.9.1 Syntax

```

public class InvalidDecoderModeException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException
|
+--org.iso.mpeg.mpegj.decoder.InvalidDecoderModeException

```

All Implemented Interfaces:

java.io.Serializable

V.3.9.2 Description

The class InvalidDecoderModeException is a subclass of MediaDecoderException. This Exception is thrown by the when a decoder mode is attempted to be set to an invalid value (by the Media APIs).

| Member Summary | |
|----------------|--|
| Constructors | |
| | <u>InvalidDecoderModeException()</u> |
| | <u>InvalidDecoderModeException(String)</u> |

V.3.9.3 Constructors

InvalidDecoderModeException()

public InvalidDecoderModeException()

Constructs an InvalidDecoderModeException with no specified detail message.

InvalidDecoderModeException(String)

public InvalidDecoderModeException(java.lang.String)

Constructs an InvalidDecoderModeException with a detailed message.

V.3.10 org.iso.mpeg.mpegj.decoder.InvalidDecoderPriorityException

V.3.10.1 Syntax

```

public class InvalidDecoderPriorityException extends
    org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.decoder.MediaDecoderException

```

```

|
++org.iso.mpeg.mpegj.decoder.InvalidDecoderPriorityException

```

All Implemented Interfaces:

java.io.Serializable

V.3.10.2 Description

The class InvalidDecoderPriorityException is a subclass of MediaDecoderException. This Exception is thrown by the when a decoder priority is attempted to be set to an invalid value (by the Resource Manager).

| Member Summary | |
|-----------------------|---|
| Constructors | |
| | InvalidDecoderPriorityException() |
| | InvalidDecoderPriorityException(String) |

V.3.10.3 Constructors**InvalidDecoderPriorityException()**

public InvalidDecoderPriorityException()

Constructs an InvalidDecoderPriorityException with no specified detail message.

InvalidDecoderPriorityException(String)

public InvalidDecoderPriorityException(java.lang.String)

Constructs an InvalidDecoderPriorityException with a detailed message.

V.3.11 org.iso.mpeg.mpegj.decoder.InvalidDecoderSpeedException**V.3.11.1 Syntax**

```

public class InvalidDecoderSpeedException extends
org.iso.mpeg.mpegj.decoder.MediaDecoderException

```

java.lang.Object

```

|
++java.lang.Throwable
|
++java.lang.Exception
|
++org.iso.mpeg.mpegj.MPEGJException
|
++org.iso.mpeg.mpegj.decoder.MediaDecoderException
|
++org.iso.mpeg.mpegj.decoder.InvalidDecoderSpeedException

```

All Implemented Interfaces:

java.io.Serializable

V.3.11.2 Description

The class InvalidDecoderSpeedException is a subclass of MediaDecoderException. This Exception is thrown by the when a decoder mode is attempted to be set to an invalid value (by the Media APIs).

| Member Summary | |
|-----------------------|--|
| Constructors | |
| | InvalidDecoderSpeedException() |
| | InvalidDecoderSpeedException(String) |

V.3.11.3 Constructors

InvalidDecoderSpeedException()
 public InvalidDecoderSpeedException()

Constructs an InvalidDecoderSpeedException with no specified detail message.

InvalidDecoderSpeedException(String)
 public InvalidDecoderSpeedException(java.lang.String)

Constructs an InvalidDecoderSpeedException with a detailed message.

V.3.12 org.iso.mpeg.mpegj.decoder.InvalidDecoderTypeException

V.3.12.1 Syntax

```
public class InvalidDecoderTypeException extends
  org.iso.mpeg.mpegj.decoder.MediaDecoderException

java.lang.Object
|
+--java.lang.Throwable
  |
  +--java.lang.Exception
    |
    +--org.iso.mpeg.mpegj.MPEGJException
      |
      +--org.iso.mpeg.mpegj.decoder.MediaDecoderException
        |
        +--org.iso.mpeg.mpegj.decoder.InvalidDecoderTypeException
```

All Implemented Interfaces:

java.io.Serializable

V.3.12.2 Description

The class InvalidDecoderTypeException is a subclass of MediaDecoderException. This Exception is thrown by the when a decoder mode is attempted to be set to an invalid value (by the Resource Manager).

| Member Summary | |
|----------------|--|
| Constructors | InvalidDecoderTypeException() InvalidDecoderTypeException(String) |

V.3.12.3 Constructors

InvalidDecoderTypeException()
 public InvalidDecoderTypeException()

Constructs an InvalidDecoderTypeException with no specified detail message.

InvalidDecoderTypeException(String)
 public InvalidDecoderTypeException(java.lang.String)

Constructs an InvalidDecoderTypeException with a detailed message.

V.3.13 org.iso.mpeg.mpegj.decoder.MediaDecoderException

V.3.13.1 Syntax

```
public class MediaDecoderException extends org.iso.mpeg.mpegj.MPEGJException
```

java.lang.Object

```

|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpeqj.MPEGJException
|
+--org.iso.mpeg.mpeqj.decoder.MediaDecoderException

```

Direct Known Subclasses:

org.iso.mpeg.mpeqj.decoder.DecoderAlreadyAttachedException,
org.iso.mpeg.mpeqj.decoder.DecoderAlreadyRunningException,
org.iso.mpeg.mpeqj.decoder.DecoderNotAttachedException,
org.iso.mpeg.mpeqj.decoder.DecoderNotFoundException,
org.iso.mpeg.mpeqj.decoder.DecoderNotRunningException,
org.iso.mpeg.mpeqj.decoder.InvalidDecoderLevelException,
org.iso.mpeg.mpeqj.decoder.InvalidDecoderModeException,
org.iso.mpeg.mpeqj.decoder.InvalidDecoderPriorityException,
org.iso.mpeg.mpeqj.decoder.InvalidDecoderSpeedException,
org.iso.mpeg.mpeqj.decoder.InvalidDecoderTypeException

All Implemented Interfaces:

java.io.Serializable

V.3.13.2 Description

The class MediaDecoderException is a subclass of MPEGJException and is the parent of all ScenManagerExceptions. This is thrown by the MediaDecoder APIs.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>MediaDecoderException()</u> <u>MediaDecoderException(String)</u> |

V.3.13.3 Constructors**MediaDecoderException()**

public MediaDecoderException()

Constructs an MediaDecoderException with no specified detail message.

MediaDecoderException(String)

public MediaDecoderException(java.lang.String)

Constructs an MediaDecoderException with a detailed message.

V.3.14 org.iso.mpeg.mpeqj.decoder.MPDecoder**V.3.14.1 Syntax**

```

public interface MPDecoder extends
org.iso.mpeg.mpeqj.resource.MPDecoderEventGenerator

```

All Superinterfaces:

org.iso.mpeg.mpeqj.resource.MPDecoderEventGenerator

V.3.14.2 Description

This is the base interface for media decoders.

| Member Summary | |
|-----------------------|-----------------------------|
| Methods | |
| void | <u>start()</u> |
| void | <u>stop()</u> |
| void | <u>pause()</u> |
| void | <u>resume()</u> |
| void | <u>attach(ESDescriptor)</u> |
| void | <u>detach()</u> |
| DecoderType | <u>getType()</u> |
| String | <u>getVendor()</u> |
| int | <u>getInstance()</u> |
| boolean | <u>isPauseable()</u> |
| ESDescriptor | <u>getESDescriptor()</u> |

V.3.14.3 Methods

attach(ESDescriptor)

```
public void attach(org.iso.mpeg.mpeqj.ESDescriptor)
```

Attach a decoder for decoding of data.

detach()

```
public void detach()
```

Detach a decoder already decoding data.

getESDescriptor()

```
public org.iso.mpeg.mpeqj.ESDescriptor getESDescriptor()
```

Get the attached ESDescriptor

getInstance()

```
public int getInstance()
```

Get instance number.

getType()

```
public org.iso.mpeg.mpeqj.decoder.DecoderType getType()
```

Get decoder type.

getVendor()

```
public java.lang.String getVendor()
```

Get decoder vendor name.

isPauseable()

```
public boolean isPauseable()
```

Determines if the decoder is pauseable.

pause()

```
public void pause()
```

Pause decoding of data.

resume()

```
public void resume()
```

Resume decoding of data from paused instant.

start()

```
public void start()
```

Start decoding of data. This method should not be called for normal decoding. Because normal decoding starts automatically from the underlying BIFS construct

stop()

```
public void stop()
```

Stop decoding of data.

V.4 package org.iso.mpeg.mpegj.net

V.4.1 Description

| Class Summary | |
|---|--|
| Interfaces <u>NetworkManager</u> <u>ChannelDescriptor</u> <u>DMIFMonitor</u> <u>ChannelController</u> <u>ServiceSessionDescriptor</u> <u>OoSDescriptor</u> Classes <u>Qualifier</u> <u>ChannelsDescriptor</u> <u>OoSData</u> <u>QualifierTag</u> Exceptions <u>AccessLayerException</u> | <p>This interface allows to retrieve all the information about a channel in a specified service session.</p> <p>This interface allows to retrieve information about a specific service session.</p> <p>This class contains all the constants that may be used to describe a Qualifier metric (see the DMIF specification).</p> |

V.4.2 org.iso.mpeg.mpegj.net.AccessLayerException

V.4.2.1 Syntax

```
public class AccessLayerException extends org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.net.AccessLayerException
```

All Implemented Interfaces:

java.io.Serializable

V.4.2.2 Description

| Member Summary | |
|-----------------------|--|
| Fields | int <u>INVALID_SERVICE_SESSION_ID</u> int <u>INVALID_STREAMPRIORITY</u> int <u>INVALID_QOSDATA</u> int <u>INVALID_QUALIFIERTAG</u> int <u>BAD_URL_STRING</u> int <u>INVALID_QUALIFIER_VALUE_TYPE</u> int <u>ACCESS_LAYER_NOT_FOUND</u> |
| Constructors | <u>AccessLayerException()</u> <u>AccessLayerException(int)</u> |
| Methods | int <u>getValue()</u> |

V.4.2.3 Fields

```
ACCESS_LAYER_NOT_FOUND
public static final int ACCESS_LAYER_NOT_FOUND

BAD_URL_STRING
public static final int BAD_URL_STRING

INVALID_QOSDATA
public static final int INVALID_QOSDATA

INVALID_QUALIFIER_VALUE_TYPE
public static final int INVALID_QUALIFIER_VALUE_TYPE

INVALID_QUALIFIERTAG
public static final int INVALID_QUALIFIERTAG

INVALID_SERVICE_SESSION_ID
public static final int INVALID_SERVICE_SESSION_ID

INVALID_STREAMPRIORITY
public static final int INVALID_STREAMPRIORITY
```

V.4.2.4 Constructors

```
AccessLayerException()
public AccessLayerException()
```

This constructor allows a method to throw an exception related to the underlying Access Layer.

```
AccessLayerException(int)
public AccessLayerException(int)
```

This constructor allows a method to throw an exception related to the underlying Access Layer.

Parameters:

Gripe - input parameter int, allows the application to know the reason of the exception. It can assume a constant value defined in this class.

V.4.2.5 Methods

```
getValue()
public int getValue()
```

This method enables the application to know the illegal parameter that caused the AccessLayerException

Returns:

An integer value defined in the class, indicating the wrong input parameter

V.4.3 org.iso.mpeg.mpegj.net.ChannelController

V.4.3.1 Syntax

```
public interface ChannelController
```

V.4.3.2 Description

| Member Summary | |
|-----------------------|---|
| Methods | <pre>void enable(long, long) void disable(long, long)</pre> |

V.4.3.3 Methods

```
disable(long, long)
public void disable(long, long)
```

This method allows to disable a specified channel in a specified service session. This means that the particular channel won't be able to accept data from the Access Layer.

Parameters:

`serviceSessionID`: - specifies the service session identifier

`channelID`: - specifies a particular channel (by giving a channel identifier) within the given service session.

enable(long, long)

`public void enable(long, long)`

This method allows to enable a specified channel in a specified service session. This means that the particular channel will be able to accept data from the Access Layer.

Parameters:

`serviceSessionID`: - specifies the service session identifier

`channelID`: - specifies a particular channel (by giving a channel identifier) within the given service session.

V.4.4 org.iso.mpeg.mpegj.net.ChannelDescriptor**V.4.4.1 Syntax**

```
public interface ChannelDescriptor
```

V.4.4.2 Description

This interface allows to retrieve all the information about a channel in a specified service session.

| Member Summary | |
|----------------|------------------------------------|
| Methods | |
| long | <code>getServiceSessionID()</code> |
| long | <code>getChannelID()</code> |
| int | <code>getAURate()</code> |
| int | <code>getError()</code> |
| int | <code>getStatus()</code> |
| QoSDescriptor | <code>getQoS()</code> |

V.4.4.3 Methods**getAURate()**

`public int getAURate()`

This method retrieves the actual Access Unit rate of the channel. This value may change over the time.

getChannelID()

`public long getChannelID()`

This method retrieves the channel identifier of the channel associated to the descriptor. Using this value it is possible to obtain both the Object Descriptor Identifier and the Elementary stream identifier associated to the channel: OD ID: (`channelID >> 6`) ES ID: (`channelID & 0x0000003F`)

getError()

`public int getError()`

This method retrieves information about error conditions associated to the channel (see DMIF specification). This value may change over the time.

getQoS()

`public org.iso.mpeg.mpegj.net.QoSDescriptor getQoS()`

This method retrieves information about the Quality of service associated to the channel (see QualifierTag).

getServiceSessionID()

`public long getServiceSessionID()`

This method retrieves the service session identifier associated to the specific channel

getStatus()

`public int getStatus()`

This method retrieves information about the status of the channel (see DMIF specification). This value may change over the time.

V.4.5 org.iso.mpeg.mpegj.net.ChannelsDescriptor

V.4.5.1 Syntax

```
public class ChannelsDescriptor extends java.lang.Object implements
    java.io.Serializable

java.lang.Object
|
+--org.iso.mpeg.mpegj.net.ChannelsDescriptor
```

All Implemented Interfaces:

java.io.Serializable

V.4.5.2 Description

| Member Summary | |
|--|---|
| Fields | |
| int long long int int QoSData | <u>auRate</u> <u>channelId</u> <u>serviceSessionId</u> <u>error</u> <u>status</u> <u>qos</u> |
| Constructors | <u>ChannelsDescriptor(long)</u> |

V.4.5.3 Fields

auRate
 public int auRate

channelId
 public long channelId

error
 public int error

qos
 public org.iso.mpeg.mpegj.net.QoSData qos

serviceSessionId
 public long serviceSessionId

status
 public int status

V.4.5.4 Constructors

ChannelsDescriptor(long)
 public ChannelsDescriptor(long)

V.4.6 org.iso.mpeg.mpegj.net.DMIFMonitor

V.4.6.1 Syntax

```
public interface DMIFMonitor
```

V.4.6.2 Description

| Member Summary | |
|-----------------------|---|
| Methods | |
| Vector Vector | <u>getServiceSessionDescriptors()</u> <u>getChannelDescriptors(long)</u> |

V.4.6.3 Methods

getChannelDescriptors(long)

```
public java.util.Vector getChannelDescriptors (long)
```

This method returns a Vector of object ChannelsDescriptors that contains informations about the channels existing in a specified session. The returned value refers to entities that may change over the time.

getServiceSessionDescriptors()

```
public java.util.Vector getServiceSessionDescriptors ()
```

This method returns a Vector of object SessionDescriptors that contains information about the existing sessions. The returned value refers to entities that may change over the time.

V.4.7 org.iso.mpeg.mpegj.net.NetworkManager

V.4.7.1 Syntax

```
public interface NetworkManager
```

V.4.7.2 Description

| Member Summary | |
|-----------------------|--|
| Methods | |
| DMIFMonitor | getDMIFMonitor() |
| ChannelController | getChannelController() |

V.4.7.3 Methods

getChannelController()

```
public org.iso.mpeg.mpegj.net.ChannelController getChannelController()
```

This method returns the ChannelController that is used to enable and disable channels

Returns:

the ChannelController if available

getDMIFMonitor()

```
public org.iso.mpeg.mpegj.net.DMIFMonitor getDMIFMonitor()
```

This method returns the DMIFMonitor that is used to retrieve all the data associated with the DMIF

Returns:

the DMIFMonitor if available

V.4.8 org.iso.mpeg.mpegj.net.QoSData

V.4.8.1 Syntax

```
public class QoSData extends java.lang.Object implements java.io.Serializable
```

```
java.lang.Object
```

```
|
```

```
+--org.iso.mpeg.mpegj.net.QoSData
```

All Implemented Interfaces:

```
java.io.Serializable
```

V.4.8.2 Description

| Member Summary | |
|-----------------------|--|
| Fields | |
| byte Vector | qualifierCount qualifiers |
| Constructors | QoSData() |

V.4.8.3 Fields

qualifierCount

public byte qualifierCount

qualifiers

public java.util.Vector qualifiers

This attributes is an array of Qualifiers objects

V.4.8.4 Constructors

QoSData()

public QoSData()

V.4.9 org.iso.mpeg.mpegj.net.QoSDescriptor

V.4.9.1 Syntax

public interface QoSDescriptor

V.4.9.2 Description

| Member Summary | |
|-----------------------|--|
| Methods | |
| byte Vector | <u>getQualifierCount()</u> <u>getQualifiers()</u> |

V.4.9.3 Methods

getQualifierCount()

public byte getQualifierCount()

getQualifiers()

public java.util.Vector getQualifiers()

This attributes is an array of Qualifiers objects

V.4.10 org.iso.mpeg.mpegj.net.Qualifier

V.4.10.1 Syntax

```
public class Qualifier extends java.lang.Object implements java.io.Serializable
java.lang.Object
|
+--org.iso.mpeg.mpegj.net.Qualifier
```

All Implemented Interfaces:

java.io.Serializable

V.4.10.2 Description

| Member Summary | |
|-----------------------|----------------------------------|
| Fields | |
| byte Number | <u>metric</u> <u>tagValue</u> |
| Constructors | |
| | <u>Qualifier()</u> |

V.4.10.3 Fields

metric
public byte metric

This attribute identifies the QoS metric type.

tagValue
public java.lang.Number tagValue

This attribute contains the value of the specified metric type

V.4.10.4 Constructors

Qualifier()
public Qualifier()

V.4.11 org.iso.mpeg.mpegj.net.QualifierTag

V.4.11.1 Syntax

```
public class QualifierTag extends java.lang.Object
    java.lang.Object
    |
    +-org.iso.mpeg.mpegj.net.QualifierTag
```

V.4.11.2 Description

This class contains all the constants that may be used to describe a Qualifier metric (see the DMIF specification).

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| byte | <u>PRIORITY</u> |
| byte | <u>MAX_DELAY</u> |
| byte | <u>AVG_DELAY</u> |
| byte | <u>LOSS_PROB</u> |
| byte | <u>MAX_GAP_LOSS</u> |
| byte | <u>MAX_AU_SIZE</u> |
| byte | <u>MAX_AU_RATE</u> |
| byte | <u>AVG_AU_SIZE</u> |
| Constructors | <u>QualifierTag()</u> |

V.4.11.3 Fields

AVG_AU_SIZE

public static final byte AVG_AU_SIZE
AVG_AU_SIZE = 0x43

AVG_DELAY

public static final byte AVG_DELAY
AVG_DELAY = 0x12

LOSS_PROB

public static final byte LOSS_PROB
LOSS_PROB = 0x13

MAX_AU_RATE

public static final byte MAX_AU_RATE
MAX_AU_RATE = 0x42

MAX_AU_SIZE

public static final byte MAX_AU_SIZE
MAX_AU_SIZE = 0x41

```

MAX_DELAY
public static final byte MAX_DELAY
MAX_DELAY = 0x11

MAX_GAP_LOSS
public static final byte MAX_GAP LOSS
MAX_GAP LOSS = 0x14

PRIORITY
public static final byte PRIORITY
PRIORITY = 0x01

```

V.4.11.4 Constructors

QualifierTag()
public QualifierTag()

V.4.12 org.iso.mpeg.mpegj.net.ServiceSessionDescriptor

V.4.12.1 Syntax

```
public interface ServiceSessionDescriptor
```

V.4.12.2 Description

This interface allows to retrieve information about a specific service session.

| Member Summary | |
|-----------------------|---------------------------------------|
| Methods | |
| String | getURL() |
| long | getServiceSessionID() |
| int | getNumberOfChannels() |

V.4.12.3 Methods

getNumberOfChannels()
public int getNumberOfChannels()

This method returns the number of the opened channels associated to the service session.

getServiceSessionID()
public long getServiceSessionID()

This method returns the service session identifier associated to the service session.

getURL()
public java.lang.String getURL()

This method returns a string describing the URL associated to the service session.

V.5 package org.iso.mpeg.mpegj.scene

V.5.1 Description

| Class Summary | |
|---------------------------------------|--|
| Interfaces | |
| Scene | An interface that acts as a proxy for a BIFS scene. |
| Node | An interface that acts as a proxy for a BIFS node in the scene graph. |
| SceneListener | An interface that allows monitoring of changes to a BIFS scene graph. |
| SceneListener.Message | The message numbers used in the notify method. |
| MFStringFieldValue | An interface used for obtaining MFString values. |
| MFFloatFieldValue | An interface used for obtaining MFFloat values. |
| MFFieldValue | A tagging interface used to classify FieldValue objects that return compound values. |
| SFStringFieldValue | An interface used for obtaining SFString values. |
| SFVec2fFieldValue | An interface used for obtaining SFVec2f values. |
| NodeType | An interface defining constants for node types. |

| | |
|--|--|
| <u>MFTimeFieldValue</u> | An interface used for obtaining MFTime values. |
| <u>SFNodeFieldValue</u> | An interface used for obtaining SFNode values. |
| <u>NodeValue</u> | An interface for node values that either act as a proxy for a node in the BIFS scene, or specify the creation of a new node. |
| <u>FieldValue</u> | A tagging interface used to identify objects that can return field values. |
| <u>Field</u> | An interface with inner classes defining the constants for the field defIDs of each node. |
| <u>Field.Anchor</u> | An interface defining constants for the field defIDs of the Anchor node. |
| <u>Field.AnimationStream</u> | An interface defining constants for the field defIDs of the AnimationStream node. |
| <u>Field.Appearance</u> | An interface defining constants for the field defIDs of the Appearance node. |
| <u>Field.AudioBuffer</u> | An interface defining constants for the field defIDs of the AudioBuffer node. |
| <u>Field.AudioClip</u> | An interface defining constants for the field defIDs of the AudioClip node. |
| <u>Field.AudioDelay</u> | An interface defining constants for the field defIDs of the AudioDelay node. |
| <u>Field.AudioFX</u> | An interface defining constants for the field defIDs of the AudioFX node. |
| <u>Field.AudioMix</u> | An interface defining constants for the field defIDs of the AudioMix node. |
| <u>Field<audiosource< u=""></audiosource<></u> | An interface defining constants for the field defIDs of the AudioSource node. |
| <u>Field.AudioSwitch</u> | An interface defining constants for the field defIDs of the AudioSwitch node. |
| <u>Field.Background</u> | An interface defining constants for the field defIDs of the Background node. |
| <u>Field.Background2D</u> | An interface defining constants for the field defIDs of the Background2D node. |
| <u>Field.Billboard</u> | An interface defining constants for the field defIDs of the Billboard node. |
| <u>Field.Bitmap</u> | An interface defining constants for the field defIDs of the Bitmap node. |
| <u>Field.Box</u> | An interface defining constants for the field defIDs of the Box node. |
| <u>Field.Circle</u> | An interface defining constants for the field defIDs of the Circle node. |
| <u>Field.Collision</u> | An interface defining constants for the field defIDs of the Collision node. |
| <u>Field.Color</u> | An interface defining constants for the field defIDs of the Color node. |
| <u>Field.ColorInterpolator</u> | An interface defining constants for the field defIDs of the ColorInterpolator node. |
| <u>Field.CompositeTexture2D</u> | An interface defining constants for the field defIDs of the CompositeTexture2D node. |
| <u>Field.CompositeTexture3D</u> | An interface defining constants for the field defIDs of the CompositeTexture3D node. |
| <u>Field.Conditional</u> | An interface defining constants for the field defIDs of the Conditional node. |
| <u>Field.Cone</u> | An interface defining constants for the field defIDs of the Cone node. |
| <u>Field.Coordinate</u> | An interface defining constants for the field defIDs of the Coordinate node. |
| <u>Field.Coordinate2D</u> | An interface defining constants for the field defIDs of the Coordinate2D node. |
| <u>Field.CoordinateInterpolator</u> | An interface defining constants for the field defIDs of the CoordinateInterpolator node. |
| <u>Field.CoordinateInterpolator2D</u> | An interface defining constants for the field defIDs of the CoordinateInterpolator2D node. |
| <u>Field.Curve2D</u> | An interface defining constants for the field defIDs of the Curve2D node. |
| <u>Field.Cylinder</u> | An interface defining constants for the field defIDs of the Cylinder node. |
| <u>Field.CylinderSensor</u> | An interface defining constants for the field defIDs of the CylinderSensor node. |
| <u>Field.DirectionalLight</u> | An interface defining constants for the field defIDs of the DirectionalLight node. |
| <u>Field.DiscSensor</u> | An interface defining constants for the field defIDs of the DiscSensor node. |
| <u>Field.ElevationGrid</u> | An interface defining constants for the field defIDs of the ElevationGrid node. |
| <u>Field.Expression</u> | An interface defining constants for the field defIDs of the Expression node. |
| <u>Field.Extrusion</u> | An interface defining constants for the field defIDs of the Extrusion node. |
| <u>Field.Face</u> | An interface defining constants for the field defIDs of the Face node. |
| <u>Field.FaceDefMesh</u> | An interface defining constants for the field defIDs of the FaceDefMesh node. |
| <u>Field.FaceDefTables</u> | An interface defining constants for the field defIDs of the FaceDefTables node. |
| <u>Field.FaceDefTransform</u> | An interface defining constants for the field defIDs of the FaceDefTransform node. |
| <u>Field.FAP</u> | An interface defining constants for the field defIDs of the FAP node. |
| <u>Field.FDP</u> | An interface defining constants for the field defIDs of the FDP node. |
| <u>Field.FIT</u> | An interface defining constants for the field defIDs of the FIT node. |
| <u>Field.Fog</u> | An interface defining constants for the field defIDs of the Fog node. |
| <u>Field.FontStyle</u> | An interface defining constants for the field defIDs of the FontStyle node. |
| <u>Field.Form</u> | An interface defining constants for the field defIDs of the Form node. |
| <u>Field.Group</u> | An interface defining constants for the field defIDs of the Group node. |
| <u>Field.ImageTexture</u> | An interface defining constants for the field defIDs of the ImageTexture node. |
| <u>Field.IndexedFaceSet</u> | An interface defining constants for the field defIDs of the IndexedFaceSet node. |
| <u>Field.IndexedFaceSet2D</u> | An interface defining constants for the field defIDs of the IndexedFaceSet2D node. |
| <u>Field.IndexedLineSet</u> | An interface defining constants for the field defIDs of the IndexedLineSet node. |
| <u>Field.IndexedLineSet2</u> | An interface defining constants for the field defIDs of the IndexedLineSet2 node. |

| | |
|---|---|
| D | |
| Field.Inline | An interface defining constants for the field defIDs of the Inline node. |
| Field.LOD | An interface defining constants for the field defIDs of the LOD node. |
| Field.Layer2D | An interface defining constants for the field defIDs of the Layer2D node. |
| Field.Layer3D | An interface defining constants for the field defIDs of the Layer3D node. |
| Field.Layout | An interface defining constants for the field defIDs of the Layout node. |
| Field.LineProperties | An interface defining constants for the field defIDs of the LineProperties node. |
| Field.ListeningPoint | An interface defining constants for the field defIDs of the ListeningPoint node. |
| Field.Material | An interface defining constants for the field defIDs of the Material node. |
| Field.Material2D | An interface defining constants for the field defIDs of the Material2D node. |
| Field.MovieTexture | An interface defining constants for the field defIDs of the MovieTexture node. |
| Field.NavigationInfo | An interface defining constants for the field defIDs of the NavigationInfo node. |
| Field.Normal | An interface defining constants for the field defIDs of the Normal node. |
| Field.NormalInterpolator | An interface defining constants for the field defIDs of the NormalInterpolator node. |
| Field.OrderedGroup | An interface defining constants for the field defIDs of the OrderedGroup node. |
| Field.OrientationInterpolator | An interface defining constants for the field defIDs of the OrientationInterpolator node. |
| Field.PixelTexture | An interface defining constants for the field defIDs of the PixelTexture node. |
| Field.PlaneSensor | An interface defining constants for the field defIDs of the PlaneSensor node. |
| Field.PlaneSensor2D | An interface defining constants for the field defIDs of the PlaneSensor2D node. |
| Field.PointLight | An interface defining constants for the field defIDs of the PointLight node. |
| Field.PointSet | An interface defining constants for the field defIDs of the PointSet node. |
| Field.PointSet2D | An interface defining constants for the field defIDs of the PointSet2D node. |
| Field.PositionInterpolator | An interface defining constants for the field defIDs of the PositionInterpolator node. |
| Field.PositionInterpolator2D | An interface defining constants for the field defIDs of the PositionInterpolator2D node. |
| Field.ProximitySensor2D | An interface defining constants for the field defIDs of the ProximitySensor2D node. |
| Field.ProximitySensor | An interface defining constants for the field defIDs of the ProximitySensor node. |
| Field.QuantizationParameter | An interface defining constants for the field defIDs of the QuantizationParameter node. |
| Field.Rectangle | An interface defining constants for the field defIDs of the Rectangle node. |
| Field.ScalarInterpolator | An interface defining constants for the field defIDs of the ScalarInterpolator node. |
| Field.Script | An interface defining constants for the field defIDs of the Script node. |
| Field.Shape | An interface defining constants for the field defIDs of the Shape node. |
| Field.Sound | An interface defining constants for the field defIDs of the Sound node. |
| Field.Sound2D | An interface defining constants for the field defIDs of the Sound2D node. |
| Field.Sphere | An interface defining constants for the field defIDs of the Sphere node. |
| Field.SphereSensor | An interface defining constants for the field defIDs of the SphereSensor node. |
| Field.SpotLight | An interface defining constants for the field defIDs of the SpotLight node. |
| Field.Switch | An interface defining constants for the field defIDs of the Switch node. |
| Field.TermCap | An interface defining constants for the field defIDs of the TermCap node. |
| Field.Text | An interface defining constants for the field defIDs of the Text node. |
| Field.TextureCoordinate | An interface defining constants for the field defIDs of the TextureCoordinate node. |
| Field.TextureTransform | An interface defining constants for the field defIDs of the TextureTransform node. |
| Field.TimeSensor | An interface defining constants for the field defIDs of the TimeSensor node. |
| Field.TouchSensor | An interface defining constants for the field defIDs of the TouchSensor node. |
| Field.Transform | An interface defining constants for the field defIDs of the Transform node. |
| Field.Transform2D | An interface defining constants for the field defIDs of the Transform2D node. |
| Field.Valuator | An interface defining constants for the field defIDs of the Valuator node. |
| Field.WorldInfo | An interface defining constants for the field defIDs of the WorldInfo node. |
| NewNode | An interface used to specify the creation of a new node. |
| SFColorFieldValue | An interface used for obtaining SFColor values. |
| MFVec2fFieldValue | An interface used for obtaining MFVec2f values. |
| EventOut | |
| EventOut.Anchor | |
| EventOut.AnimationStream | |
| EventOut.Appearance | |
| EventOut.AudioBuffer | |

EventOut.AudioClip
EventOut.AudioDelay
EventOut.AudioFX
EventOut.AudioMix
EventOut
EventOut.AudioSwitch
EventOut.Background
EventOut.Background2D
EventOut.Billboard
EventOut.Bitmap
EventOut.Box
EventOut.Circle
EventOut.Collision
EventOut.Color
EventOut.ColorInterpolator
EventOut.CompositeTexture2D
EventOut.CompositeTexture3D
EventOut.Conditional
EventOut.Cone
EventOut.Coordinate
EventOut.Coordinate2D
EventOut.CoordinateInterpolator
EventOut.CoordinateInterpolator2D
EventOut.Curve2D
EventOut.Cylinder
EventOut.CylinderSensor
EventOut.DirectionalLight
EventOut.DiscSensor
EventOut.ElevationGrid
EventOut.Expression
EventOut.Extrusion
EventOut.Face
EventOut.FaceDefMesh
EventOut.FaceDefTables
EventOut.FaceDefTransform
EventOut.FAP
EventOut.FDP
EventOut.FIT
EventOut.Fog
EventOut.FontStyle
EventOut.Form
EventOut.Group
EventOut.ImageTexture
EventOut.IndexedFaceSet
EventOut.IndexedFaceSet2D
EventOut.IndexedLineSet
EventOut.IndexedLineSet2D
EventOut.Inline
EventOut.LOD
EventOut.Layer2D
EventOut.Layer3D
EventOut.Layout

| | |
|---|--|
| <u>EventOut.LineProperties</u> | |
| <u>EventOut.ListeningPoint</u> | |
| <u>EventOut.Material</u> | |
| <u>EventOut.Material2D</u> | |
| <u>EventOut.MovieTexture</u> | |
| <u>EventOut.NavigationInfo</u> | |
| <u>EventOut.Normal</u> | |
| <u>EventOut.NormalInterpolator</u> | |
| <u>EventOut.OrderedGroup</u> | |
| <u>EventOut.OrientationInterpolator</u> | |
| <u>EventOut.PixelTexture</u> | |
| <u>EventOut.PlaneSensor</u> | |
| <u>EventOut.PlaneSensor2D</u> | |
| <u>EventOut.PointLight</u> | |
| <u>EventOut.PointSet</u> | |
| <u>EventOut.PointSet2D</u> | |
| <u>EventOut.PositionInterpolator</u> | |
| <u>EventOut.PositionInterpolator2D</u> | |
| <u>EventOut.ProximitySensor2D</u> | |
| <u>EventOut.ProximitySensor</u> | |
| <u>EventOut.QuantizationParameter</u> | |
| <u>EventOut.Rectangle</u> | |
| <u>EventOut.ScalarInterpolator</u> | |
| <u>EventOut.Script</u> | |
| <u>EventOut.Shape</u> | |
| <u>EventOut.Sound</u> | |
| <u>EventOut.Sound2D</u> | |
| <u>EventOut.Sphere</u> | |
| <u>EventOut.SphereSensor</u> | |
| <u>EventOut.SpotLight</u> | |
| <u>EventOut.Switch</u> | |
| <u>EventOut.TermCap</u> | |
| <u>EventOut.Text</u> | |
| <u>EventOut.TextureCoordinate</u> | |
| <u>EventOut.TextureTransform</u> | |
| <u>EventOut.TimeSensor</u> | |
| <u>EventOut.TouchSensor</u> | |
| <u>EventOut.Transform</u> | |
| <u>EventOut.Transform2D</u> | |
| <u>EventOut.Valuator</u> | |
| <u>EventOut.Viewpoint</u> | |
| <u>EventOut.VisibilitySensor</u> | |
| <u>EventOut.Viseme</u> | |
| <u>EventOut.WorldInfo</u> | |
| <u>SFRotationFieldValue</u> | An interface used for obtaining SFRotation values. |
| <u>MFColorFieldValue</u> | An interface used for obtaining MFColor values. |
| <u>SFVec3fFieldValue</u> | An interface used for obtaining SFVec3f values. |
| <u>SFInt32FieldValue</u> | An interface used for obtaining SFInt32 values. |
| <u>SceneManager</u> | An interface that allows access to the MPEG-4 terminal's native scene. |
| <u>MFNodeFieldValue</u> | An interface used for obtaining MFNode values. |
| <u>SFBoolFieldValue</u> | An interface used for obtaining SFBool values. |

| | |
|---|--|
| <code>EventOutListener</code> | An interface to be implemented by objects that wish to receive eventOut notification from fields in the scene. |
| <code>EventIn</code> | |
| <code>EventIn.Anchor</code> | |
| <code>EventIn.AnimationStream</code> | |
| <code>EventIn.Appearance</code> | |
| <code>EventIn.AudioBuffer</code> | |
| <code>EventIn.AudioClip</code> | |
| <code>EventIn.AudioDelay</code> | |
| <code>EventIn.AudioFX</code> | |
| <code>EventIn.AudioMix</code> | |
| <code>EventIn<audiosource></audiosource></code> | |
| <code>EventIn.AudioSwitch</code> | |
| <code>EventIn.Background</code> | |
| <code>EventIn.Background2D</code> | |
| <code>EventIn.Billboard</code> | |
| <code>EventIn.Bitmap</code> | |
| <code>EventIn.Box</code> | |
| <code>EventIn.Circle</code> | |
| <code>EventIn.Collision</code> | |
| <code>EventIn.Color</code> | |
| <code>EventIn.ColorInterpolator</code> | |
| <code>Event-</code> | |
| <code>EventIn.CompositeTexture2D</code> | |
| <code>Event-</code> | |
| <code>EventIn.CompositeTexture3D</code> | |
| <code>EventIn.Conditional</code> | |
| <code>EventIn.Cone</code> | |
| <code>EventIn.Coordinate</code> | |
| <code>EventIn.Coordinate2D</code> | |
| <code>EventIn.CoordinateInterpolator</code> | |
| <code>Event-</code> | |
| <code>EventIn.CoordinateInterpolator2D</code> | |
| <code>EventIn.Curve2D</code> | |
| <code>EventIn.Cylinder</code> | |
| <code>EventIn.CylinderSensor</code> | |
| <code>EventIn.DirectionalLight</code> | |
| <code>EventIn.DiscSensor</code> | |
| <code>EventIn.ElevationGrid</code> | |
| <code>EventIn.Expression</code> | |
| <code>EventIn.Extrusion</code> | |
| <code>EventIn.Face</code> | |
| <code>EventIn.FaceDefMesh</code> | |
| <code>EventIn.FaceDefTables</code> | |
| <code>EventIn.FaceDefTransform</code> | |
| <code>EventIn.FAP</code> | |
| <code>EventIn.FDP</code> | |
| <code>EventIn.FIT</code> | |
| <code>EventIn.Fog</code> | |
| <code>EventIn.FontStyle</code> | |
| <code>EventIn.Form</code> | |
| <code>EventIn.Group</code> | |
| <code>EventIn.ImageTexture</code> | |
| <code>EventIn.IndexedFaceSet</code> | |
| <code>Event-</code> | |

tIn.IndexedFaceSet2D
EventIn.Indexed-
LineSet
Even-
tIn.IndexedLineSet2D
EventIn.Inline
EventIn.LOD
EventIn.Layer2D
EventIn.Layer3D
EventIn.Layout
EventIn.LineProper-
ties
EventIn.Listening-
Point
EventIn.Material
EventIn.Material2D
EventIn.MovieTexture
EventIn.Navigation-
Info
EventIn.Normal
EventIn.NormalInter-
polator
EventIn.OrderedGroup
EventIn.Orientation-
Interpolator
EventIn.PixelTexture
EventIn.Planesensor
EventIn.Planesensor2D
EventIn.PointLight
EventIn.PointSet
EventIn.PointSet2D
EventIn.PositionInter-
polator
Even-
tIn.PositionInterpola-
tor2D
Even-
tIn.ProximitySensor2D
EventIn.ProximitySen-
sor
EventIn.Quantization-
Parameter
EventIn.Rectangle
EventIn.ScalarInter-
polator
EventIn.Script
EventIn.Shape
EventIn.Sound
EventIn.Sound2D
EventIn.Sphere
EventIn.SphereSensor
EventIn.SpotLight
EventIn.Switch
EventIn.TermCap
EventIn.Text
EventIn.TextureCoor-
dinate
EventIn.TextureTrans-
form
EventIn.TimeSensor
EventIn.TouchSensor
EventIn.Transform
EventIn.Transform2D
EventIn.Valuator
EventIn.Viewpoint
EventIn.Visibility-

| | |
|------------------------------|---|
| <u>Sensor</u> | |
| <u>EventIn.Viseme</u> | |
| <u>EventIn.WorldInfo</u> | |
| <u>MFRotationFieldValue</u> | An interface used for obtaining MFRotation values. |
| <u>SFTimeFieldValue</u> | An interface used for obtaining SFTime values. |
| <u>SFFloatFieldValue</u> | An interface used for obtaining SFFloat values. |
| <u>MFVec3fFieldValue</u> | An interface used for obtaining MFVec3f values. |
| <u>MFInt32FieldValue</u> | An interface used for obtaining MFInt32 values. |
| Exceptions | |
| <u>InvalidSceneException</u> | An exception used by this package to indicate that an operation was attempted on a Scene that is no longer valid. |
| <u>BadNodeException</u> | The class BadNodeException is a subclass of MPEGJException. |
| <u>BadParameterException</u> | An exception used by this package to indicate that a parameter to a member function is not valid. |
| <u>InvalidNodeException</u> | An exception used to indicate that an operation was attempted on a node that is no longer valid. |

V.5.2 org.iso.mpeg.mpegj.scene.BadNodeException

V.5.2.1 Syntax

```
public class BadNodeException extends org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.scene.BadNodeException
```

All Implemented Interfaces:

java.io.Serializable

V.5.2.2 Description

The class BadNodeException is a subclass of MPEGJException. This Exception is thrown by the method getRenderer() of Resource Manager.

| Member Summary | |
|---------------------|--|
| Constructors | <u>BadNodeException()</u> <u>BadNodeException(String)</u> |

V.5.2.3 Constructors

BadNodeException()

public BadNodeException()

Constructs an BadNodeException with no specified detail message.

BadNodeException(String)

public BadNodeException(java.lang.String)

Constructs an RendererFoundException with a detailed message.

V.5.3 org.iso.mpeg.mpegj.scene.BadParameterException

V.5.3.1 Syntax

```
public class BadParameterException extends org.iso.mpeg.mpegj.MPEGJException
```

```

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.scene.BadParameterException

```

All Implemented Interfaces:

java.io.Serializable

V.5.3.2 Description

An exception used by this package to indicate that a parameter to a member function is not valid.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>BadParameterException()</u> <u>BadParameterException(String)</u> |

V.5.3.3 Constructors**BadParameterException()**

public BadParameterException()

Default constructor.

BadParameterException(String)

public BadParameterException(java.lang.String)

String constructor.

V.5.4 org.iso.mpeg.mpegj.scene.EventIn**V.5.4.1 Syntax**

public interface EventIn

V.5.4.2 Description

| Member Summary | |
|-----------------------|--|
| Inner Classes | <u>EventIn.Anchor</u> <u>EventIn.AnimationStream</u> <u>EventIn.Appearance</u> <u>EventIn.AudioBuffer</u> <u>EventIn.AudioClip</u> <u>EventIn.AudioDelay</u> <u>EventIn.AudioFX</u> <u>EventIn.AudioMix</u> <u>EventIn<audiosource< u=""></audiosource<></u> <u>EventIn.AudioSwitch</u> <u>EventIn.Background</u> <u>EventIn.Background2D</u> <u>EventIn.Billboard</u> <u>EventIn.Bitmap</u> <u>EventIn.Box</u> <u>EventIn.Circle</u> <u>EventIn.Collision</u> <u>EventIn.Color</u> <u>EventIn.ColorInterpolator</u> |

```

static interface EventIn.CompositeTexture2D
static interface EventIn.CompositeTexture3D
static interface EventIn.Conditional
static interface EventIn.Cone
static interface EventIn.Coordinate
static interface EventIn.Coordinate2D
static interface EventIn.CoordinateInterpolator
static interface EventIn.CoordinateInterpolator2D
static interface EventIn.Curve2D
static interface EventIn.Cylinder
static interface EventIn.CylinderSensor
static interface EventIn.DirectionalLight
static interface EventIn.DiscSensor
static interface EventIn.ElevationGrid
static interface EventIn.Expression
static interface EventIn.Extrusion
static interface EventIn.Face
static interface EventIn.FaceDefMesh
static interface EventIn.FaceDefTables
static interface EventIn.FaceDefTransform
static interface EventIn.FAP
static interface EventIn.FDP
static interface EventIn.FIT
static interface EventIn.Fog
static interface EventIn.FontStyle
static interface EventIn.Form
static interface EventIn.Group
static interface EventIn.ImageTexture
static interface EventIn.IndexedFaceSet
static interface EventIn.IndexedFaceSet2D
static interface EventIn.IndexedLineSet
static interface EventIn.IndexedLineSet2D
static interface EventIn.Inline
static interface EventIn.LOD
static interface EventIn.Layer2D
static interface EventIn.Layer3D
static interface EventIn.Layout
static interface EventIn.LineProperties
static interface EventIn.ListeningPoint
static interface EventIn.Material
static interface EventIn.Material2D
static interface EventIn.MovieTexture
static interface EventIn.NavigationInfo
static interface EventIn.Normal
static interface EventIn.NormalInterpolator
static interface EventIn.OrderedGroup
static interface EventIn.OrientationInterpolator
static interface EventIn.PixelTexture
static interface EventIn.PlanarSensor
static interface EventIn.PlanarSensor2D
static interface EventIn.PointLight
static interface EventIn.PointSet
static interface EventIn.PointSet2D
static interface EventIn.PositionInterpolator
static interface EventIn.PositionInterpolator2D
static interface EventIn.ProximitySensor2D
static interface EventIn.ProximitySensor
static interface EventIn.QuantizationParameter
static interface EventIn.Rectangle
static interface EventIn.ScalarInterpolator
static interface EventIn.Script
static interface EventIn.Shape
static interface EventIn.Sound
static interface EventIn.Sound2D
static interface EventIn.Sphere
static interface EventIn.SphereSensor
static interface EventIn.SpotLight
static interface EventIn.Switch
static interface EventIn.TermCap
static interface EventIn.Text
static interface EventIn.TextureCoordinate

```

| | |
|------------------|---------------------------------|
| static interface | <u>EventIn.TextureTransform</u> |
| static interface | <u>EventIn.TimeSensor</u> |
| static interface | <u>EventIn.TouchSensor</u> |
| static interface | <u>EventIn.Transform</u> |
| static interface | <u>EventIn.Transform2D</u> |
| static interface | <u>EventIn.Valuator</u> |
| static interface | <u>EventIn.Viewpoint</u> |
| static interface | <u>EventIn.VisibilitySensor</u> |
| static interface | <u>EventIn.Viseme</u> |
| static interface | <u>EventIn.WorldInfo</u> |

V.5.5 org.iso.mpeg.mpegj.scene.EventIn.Anchor

V.5.5.1 Syntax

```
public static interface EventIn.Anchor
```

V.5.5.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>description</u> |
| int | <u>parameter</u> |
| int | <u>url</u> |

V.5.5.3 Fields

addChildren

```
public static final int addChildren
```

addChildren = 0

children

```
public static final int children
```

children = 2

description

```
public static final int description
```

description = 3

parameter

```
public static final int parameter
```

parameter = 4

removeChildren

```
public static final int removeChildren
```

removeChildren = 1

url

```
public static final int url
```

url = 5

V.5.6 org.iso.mpeg.mpegj.scene.EventIn.AnimationStream

V.5.6.1 Syntax

```
public static interface EventIn.AnimationStream
```

V.5.6.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |

| | |
|-----|------------------|
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |

V.5.6.3 Fields

loop
 public static final int loop
 loop = 0

speed
 public static final int speed
 speed = 1

startTime
 public static final int startTime
 startTime = 2

stopTime
 public static final int stopTime
 stopTime = 3

url
 public static final int url
 url = 4

V.5.7 org.iso.mpeg.mpegj.scene.EventIn.Appearance

V.5.7.1 Syntax

```
public static interface EventIn.Appearance
```

V.5.7.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>material</u> |
| int | <u>texture</u> |
| int | <u>textureTransform</u> |

V.5.7.3 Fields

material
 public static final int material
 material = 0

texture
 public static final int texture
 texture = 1

textureTransform
 public static final int textureTransform
 textureTransform = 2

V.5.8 org.iso.mpeg.mpegj.scene.EventIn.AudioBuffer

V.5.8.1 Syntax

```
public static interface EventIn.AudioBuffer
```

V.5.8.2 Description

| Member Summary | |
|-----------------------|--|
| Fields | |

| | |
|-----|-------------------|
| int | <u>loop</u> |
| int | <u>pitch</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>children</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.8.3 Fields

children

public static final int children
children = 4

loop

public static final int loop
loop = 0

numChan

public static final int numChan
numChan = 5

phaseGroup

public static final int phaseGroup
phaseGroup = 6

pitch

public static final int pitch
pitch = 1

startTime

public static final int startTime
startTime = 2

stopTime

public static final int stopTime
stopTime = 3

V.5.9 org.iso.mpeg.mpegj.scene.EventIn.AudioClip

V.5.9.1 Syntax

public static interface EventIn.AudioClip

V.5.9.2 Description

| Member Summary | |
|----------------|--|
| Fields | int <u>description</u> int <u>loop</u> int <u>pitch</u> int <u>startTime</u> int <u>stopTime</u> int <u>url</u> |

V.5.9.3 Fields

description

public static final int description
description = 0

loop

public static final int loop
loop = 1

```

pitch
public static final int pitch
pitch = 2

startTime
public static final int startTime
startTime = 3

stopTime
public static final int stopTime
stopTime = 4

url
public static final int url
url = 5

```

V.5.10 org.iso.mpeg.mpegj.scene.EventIn.AudioDelay**V.5.10.1 Syntax**

```
public static interface EventIn.AudioDelay
```

V.5.10.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>delay</u> |

V.5.10.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

children
public static final int children
children = 2

delay
public static final int delay
delay = 3

removeChildren
public static final int removeChildren
removeChildren = 1

```

V.5.11 org.iso.mpeg.mpegj.scene.EventIn.AudioFX**V.5.11.1 Syntax**

```
public static interface EventIn.AudioFX
```

V.5.11.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>orch</u> |
| int | <u>score</u> |
| int | <u>params</u> |

V.5.11.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

children
public static final int children
children = 2

orch
public static final int orch
orch = 3

params
public static final int params
params = 5

removeChildren
public static final int removeChildren
removeChildren = 1

score
public static final int score
score = 4

```

V.5.12 org.iso.mpeg.mpegj.scene.EventIn.AudioMix

V.5.12.1 Syntax

```
public static interface EventIn.AudioMix
```

V.5.12.2 Description

| Member Summary | |
|----------------|---------------------------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>numInputs</u> |
| int | <u>matrix</u> |

V.5.12.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

children
public static final int children
children = 2

matrix
public static final int matrix
matrix = 4

numInputs
public static final int numInputs
numInputs = 3

removeChildren
public static final int removeChildren
removeChildren = 1

```

V.5.13 org.iso.mpeg.mpegj.scene.EventIn.AudioSource**V.5.13.1 Syntax**

```
public static interface EventIn.AudioSource
```

V.5.13.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>url</u> |
| int | <u>pitch</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |

V.5.13.3 Fields**addChildren**

```
public static final int addChildren
```

```
addChildren = 0
```

children

```
public static final int children
```

```
children = 2
```

pitch

```
public static final int pitch
```

```
pitch = 4
```

removeChildren

```
public static final int removeChildren
```

```
removeChildren = 1
```

speed

```
public static final int speed
```

```
speed = 5
```

startTime

```
public static final int startTime
```

```
startTime = 6
```

stopTime

```
public static final int stopTime
```

```
stopTime = 7
```

url

```
public static final int url
```

```
url = 3
```

V.5.14 org.iso.mpeg.mpegj.scene.EventIn.AudioSwitch**V.5.14.1 Syntax**

```
public static interface EventIn.AudioSwitch
```

V.5.14.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |

| | |
|-----|--------------------|
| int | <u>whichChoice</u> |
|-----|--------------------|

V.5.14.3 Fields

addChildren

public static final int addChildren

addChildren = 0

children

public static final int children

children = 2

removeChildren

public static final int removeChildren

removeChildren = 1

whichChoice

public static final int whichChoice

whichChoice = 3

V.5.15 org.iso.mpeg.mpegj.scene.EventIn.Background

V.5.15.1 Syntax

public static interface EventIn.Background

V.5.15.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>set_bind</u> |
| int | <u>groundColor</u> |
| int | <u>groundColor</u> |
| int | <u>backUrl</u> |
| int | <u>bottomUrl</u> |
| int | <u>frontUrl</u> |
| int | <u>leftUrl</u> |
| int | <u>rightUrl</u> |
| int | <u>topUrl</u> |
| int | <u>skyAngle</u> |
| int | <u>skyColor</u> |

V.5.15.3 Fields

backUrl

public static final int backUrl

backUrl = 3

bottomUrl

public static final int bottomUrl

bottomUrl = 4

frontUrl

public static final int frontUrl

frontUrl = 5

groundColor

public static final int groundAngle

groundColor = 1

groundColor

public static final int groundColor

groundColor = 2

leftUrl

```
public static final int leftUrl
leftUrl = 6
rightUrl
public static final int rightUrl
rightUrl = 7
set_bind
public static final int set_bind
set_bind = 0
skyAngle
public static final int skyAngle
skyAngle = 9
skyColor
public static final int skyColor
skyColor = 10
topUrl
public static final int topUrl
topUrl = 8
```

V.5.16 org.iso.mpeg.mpegj.scene.EventIn.Background2D

V.5.16.1 Syntax

```
public static interface EventIn.Background2D
```

V.5.16.2 Description

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>set_bind</u> |
| int | <u>backColor</u> |
| int | <u>url</u> |

V.5.16.3 Fields

```
backColor
public static final int backColor
backColor = 1
set_bind
public static final int set_bind
set_bind = 0
url
public static final int url
url = 2
```

V.5.17 org.iso.mpeg.mpegj.scene.EventIn.Billboard

V.5.17.1 Syntax

```
public static interface EventIn.Billboard
```

V.5.17.2 Description

| Member Summary | |
|----------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |

| | |
|-----|-----------------------|
| int | <u>axisOfRotation</u> |
|-----|-----------------------|

V.5.17.3 Fields

addChildren

public static final int addChildren

addChildren = 0

axisOfRotation

public static final int axisOfRotation

axisOfRotation = 3

children

public static final int children

children = 2

removeChildren

public static final int removeChildren

removeChildren = 1

V.5.18 org.iso.mpeg.mpegj.scene.EventIn.Bitmap

V.5.18.1 Syntax

public static interface EventIn.Bitmap

V.5.18.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | int <u>scale</u> |

V.5.18.3 Fields

scale

public static final int scale

scale = 0

V.5.19 org.iso.mpeg.mpegj.scene.EventIn.Box

V.5.19.1 Syntax

public static interface EventIn.Box

V.5.19.2 Description

V.5.20 org.iso.mpeg.mpegj.scene.EventIn.Circle

V.5.20.1 Syntax

public static interface EventIn.Circle

V.5.20.2 Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | int <u>radius</u> |

V.5.20.3 Fields

radius

public static final int radius

radius = 0

V.5.21 org.iso.mpeg.mpegj.scene.EventIn.Collision

V.5.21.1 Syntax

```
public static interface EventIn.Collision
```

V.5.21.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>collide</u> |

V.5.21.3 Fields

addChildren

```
public static final int addChildren
```

addChildren = 0

children

```
public static final int children
```

children = 2

collide

```
public static final int collide
```

collide = 3

removeChildren

```
public static final int removeChildren
```

removeChildren = 1

V.5.22 org.iso.mpeg.mpegj.scene.EventIn.Color

V.5.22.1 Syntax

```
public static interface EventIn.Color
```

V.5.22.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>color</u> |

V.5.22.3 Fields

color

```
public static final int color
```

color = 0

V.5.23 org.iso.mpeg.mpegj.scene.EventIn.ColorInterpolator

V.5.23.1 Syntax

```
public static interface EventIn.ColorInterpolator
```

V.5.23.2 Description

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |

| | |
|-----|-----------------|
| int | key |
| int | keyValue |

V.5.23.3 Fields

```

key
public static final int key
key = 1

keyValue
public static final int keyValue
keyValue = 2

set_fraction
public static final int set_fraction
set_fraction = 0

```

V.5.24 org.iso.mpeg.mpegj.scene.EventIn.CompositeTexture2D

V.5.24.1 Syntax

```
public static interface EventIn.CompositeTexture2D
```

V.5.24.2 Description

| Member Summary | | | | | | | | | | | | | | | |
|---|---------------------------------------|------------------------------------|-----|---------------------------------------|-----|---------------------------------|-----|-----------------------------------|-----|------------------------------------|-----|-----------------------------------|-----|---------------------------------|--|
| Fields <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">int</td><td style="width: 85%;"><u>addChildren</u></td></tr> <tr> <td>int</td><td><u>removeChildren</u></td></tr> <tr> <td>int</td><td><u>children</u></td></tr> <tr> <td>int</td><td><u>pixelWidth</u></td></tr> <tr> <td>int</td><td><u>pixelHeight</u></td></tr> <tr> <td>int</td><td><u>background</u></td></tr> <tr> <td>int</td><td><u>viewport</u></td></tr> </table> | int | <u>addChildren</u> | int | <u>removeChildren</u> | int | <u>children</u> | int | <u>pixelWidth</u> | int | <u>pixelHeight</u> | int | <u>background</u> | int | <u>viewport</u> | |
| int | <u>addChildren</u> | | | | | | | | | | | | | | |
| int | <u>removeChildren</u> | | | | | | | | | | | | | | |
| int | <u>children</u> | | | | | | | | | | | | | | |
| int | <u>pixelWidth</u> | | | | | | | | | | | | | | |
| int | <u>pixelHeight</u> | | | | | | | | | | | | | | |
| int | <u>background</u> | | | | | | | | | | | | | | |
| int | <u>viewport</u> | | | | | | | | | | | | | | |

V.5.24.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

background
public static final int background
background = 5

children
public static final int children
children = 2

pixelHeight
public static final int pixelHeight
pixelHeight = 4

pixelWidth
public static final int pixelWidth
pixelWidth = 3

removeChildren
public static final int removeChildren
removeChildren = 1

viewport
public static final int viewport
viewport = 6

```

V.5.25 org.iso.mpeg.mpegj.scene.EventIn.CompositeTexture3D**V.5.25.1 Syntax**

```
public static interface EventIn.CompositeTexture3D
```

V.5.25.2 Description

| Member Summary | |
|-----------------------|---------------------------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>pixelWidth</u> |
| int | <u>pixelHeight</u> |
| int | <u>background</u> |
| int | <u>fog</u> |
| int | <u>navigationInfo</u> |
| int | <u>viewpoint</u> |

V.5.25.3 Fields

addChildren
 public static final int addChildren
 addChildren = 0

background
 public static final int background
 background = 5

children
 public static final int children
 children = 2

fog
 public static final int fog
 fog = 6

navigationInfo
 public static final int navigationInfo
 navigationInfo = 7

pixelHeight
 public static final int pixelHeight
 pixelHeight = 4

pixelWidth
 public static final int pixelWidth
 pixelWidth = 3

removeChildren
 public static final int removeChildren
 removeChildren = 1

viewpoint
 public static final int viewpoint
 viewpoint = 8

V.5.26 org.iso.mpeg.mpegj.scene.EventIn.Conditional**V.5.26.1 Syntax**

```
public static interface EventIn.Conditional
```

V.5.26.2 Description

| Member Summary | |
|-----------------------|------------------------|
| Fields | |
| int | <u>activate</u> |
| int | <u>reverseActivate</u> |
| int | <u>buffer</u> |

V.5.26.3 Fields

activate

```
public static final int activate
```

activate = 0

buffer

```
public static final int buffer
```

buffer = 2

reverseActivate

```
public static final int reverseActivate
```

reverseActivate = 1

V.5.27 org.iso.mpeg.mpegj.scene.EventIn.Cone

V.5.27.1 Syntax

```
public static interface EventIn.Cone
```

V.5.27.2 Description

V.5.28 org.iso.mpeg.mpegj.scene.EventIn.Coordinate

V.5.28.1 Syntax

```
public static interface EventIn.Coordinate
```

V.5.28.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.28.3 Fields

point

```
public static final int point
```

point = 0

V.5.29 org.iso.mpeg.mpegj.scene.EventIn.Coordinate2D

V.5.29.1 Syntax

```
public static interface EventIn.Coordinate2D
```

V.5.29.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.29.3 Fields

point

```
public static final int point
```

point = 0

V.5.30 org.iso.mpeg.mpegj.scene.EventIn.CoordinateInterpolator

V.5.30.1 Syntax

```
public static interface EventIn.CoordinateInterpolator
```

V.5.30.2 Description

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.30.3 Fields

key
public static final int key

key = 1

keyValue
public static final int keyValue

keyValue = 2

set_fraction
public static final int set_fraction
set_fraction = 0

V.5.31 org.iso.mpeg.mpegj.scene.EventIn.CoordinateInterpolator2D

V.5.31.1 Syntax

```
public static interface EventIn.CoordinateInterpolator2D
```

V.5.31.2 Description

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.31.3 Fields

key
public static final int key

key = 1

keyValue
public static final int keyValue

keyValue = 2

set_fraction
public static final int set_fraction
set_fraction = 0

V.5.32 org.iso.mpeg.mpegj.scene.EventIn.Curve2D

V.5.32.1 Syntax

```
public static interface EventIn.Curve2D
```

V.5.32.2 Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>point</u> |
| int | <u>fineness</u> |
| int | <u>type</u> |

V.5.32.3 Fields

fineness

public static final int fineness

fineness = 1

point

public static final int point

point = 0

type

public static final int type

type = 2

V.5.33 org.iso.mpeg.mpegj.scene.EventIn.Cylinder

V.5.33.1 Syntax

public static interface EventIn.Cylinder

V.5.33.2 Description

V.5.34 org.iso.mpeg.mpegj.scene.EventIn.CylinderSensor

V.5.34.1 Syntax

public static interface EventIn.CylinderSensor

V.5.34.2 Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>diskAngle</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |

V.5.34.3 Fields

autoOffset

public static final int autoOffset

autoOffset = 0

diskAngle

public static final int diskAngle

diskAngle = 1

enabled

public static final int enabled

enabled = 2

maxAngle

public static final int maxAngle

maxAngle = 3

minAngle

```
public static final int minAngle
```

```
minAngle = 4
```

offset

```
public static final int offset
```

```
offset = 5
```

V.5.35 org.iso.mpeg.mpegj.scene.EventIn.DirectionalLight**V.5.35.1 Syntax**

```
public static interface EventIn.DirectionalLight
```

V.5.35.2 Description

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>color</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>on</u> |

V.5.35.3 Fields**ambientIntensity**

```
public static final int ambientIntensity
```

```
ambientIntensity = 0
```

color

```
public static final int color
```

```
color = 1
```

direction

```
public static final int direction
```

```
direction = 2
```

intensity

```
public static final int intensity
```

```
intensity = 3
```

on

```
public static final int on
```

```
on = 4
```

V.5.36 org.iso.mpeg.mpegj.scene.EventIn.DiscSensor**V.5.36.1 Syntax**

```
public static interface EventIn.DiscSensor
```

V.5.36.2 Description

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |

V.5.36.3 Fields

```

autoOffset
public static final int autoOffset

enabled
public static final int enabled
enabled = 1

maxAngle
public static final int maxAngle
maxAngle = 2

minAngle
public static final int minAngle
minAngle = 3

offset
public static final int offset
offset = 4

```

V.5.37 org.iso.mpeg.mpegj.scene.EventIn.ElevationGrid

V.5.37.1 Syntax

```
public static interface EventIn.ElevationGrid
```

V.5.37.2 Description

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>set_height</u> |
| int | <u>color</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |

V.5.37.3 Fields

```

color
public static final int color
color = 1

normal
public static final int normal
normal = 2

set_height
public static final int set_height
set_height = 0

texCoord
public static final int texCoord
texCoord = 3

```

V.5.38 org.iso.mpeg.mpegj.scene.EventIn.Expression

V.5.38.1 Syntax

```
public static interface EventIn.Expression
```

V.5.38.2 Description

| Member Summary | |
|----------------|---------------------------|
| Fields | |
| int | <u>expression_select1</u> |

| | |
|-----|------------------------------|
| int | <u>expression_intensity1</u> |
| int | <u>expression_select2</u> |
| int | <u>expression_intensity2</u> |
| int | <u>init_face</u> |
| int | <u>expression_def</u> |

V.5.38.3 Fields

```

expression_def
public static final int expression_def
expression_def = 5

expression_intensity1
public static final int expression_intensity1
expression_intensity1 = 1

expression_intensity2
public static final int expression_intensity2
expression_intensity2 = 3

expression_select1
public static final int expression_select1
expression_select1 = 0

expression_select2
public static final int expression_select2
expression_select2 = 2

init_face
public static final int init_face
init_face = 4

```

V.5.39 org.iso.mpeg.mpegj.scene.EventIn.Extrusion

V.5.39.1 Syntax

```
public static interface EventIn.Extrusion
```

V.5.39.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>set_crossSection</u> |
| int | <u>set_orientation</u> |
| int | <u>set_scale</u> |
| int | <u>set_spine</u> |

V.5.39.3 Fields

```

set_crossSection
public static final int set_crossSection
set_crossSection = 0

set_orientation
public static final int set_orientation
set_orientation = 1

set_scale
public static final int set_scale
set_scale = 2

set_spine
public static final int set_spine
set_spine = 3

```

V.5.40 org.iso.mpeg.mpegj.scene.EventIn.Face**V.5.40.1 Syntax**

```
public static interface EventIn.Face
```

V.5.40.2 Description

| Member Summary | |
|-----------------------|-------------------------------------|
| Fields | |
| int | <u>fap</u> |
| int | <u>fdp</u> |
| int | <u>fit</u> |
| int | <u>ttsSource</u> |
| int | <u>renderedFace</u> |

V.5.40.3 Fields**fap**

```
public static final int fap
```

fap = 0

fdp

```
public static final int fdp
```

fdp = 1

fit

```
public static final int fit
```

fit = 2

renderedFace

```
public static final int renderedFace
```

renderedFace = 4

ttsSource

```
public static final int ttsSource
```

ttsSource = 3

V.5.41 org.iso.mpeg.mpegj.scene.EventIn.FaceDefMesh**V.5.41.1 Syntax**

```
public static interface EventIn.FaceDefMesh
```

V.5.41.2 Description**V.5.42 org.iso.mpeg.mpegj.scene.EventIn.FaceDefTables****V.5.42.1 Syntax**

```
public static interface EventIn.FaceDefTables
```

V.5.42.2 Description

| Member Summary | |
|-----------------------|---|
| Fields | |
| int | <u>faceDefMesh</u> |
| int | <u>faceDefTransform</u> |

V.5.42.3 Fields**faceDefMesh**

```
public static final int faceDefMesh
```

faceDefMesh = 0

faceDefTransform

```
public static final int faceDefTransform
faceDefTransform = 1
```

V.5.43 org.iso.mpeg.mpegj.scene.EventIn.FaceDefTransform**V.5.43.1 Syntax**

```
public static interface EventIn.FaceDefTransform
```

V.5.43.2 Description**V.5.44 org.iso.mpeg.mpegj.scene.EventIn.FAP****V.5.44.1 Syntax**

```
public static interface EventIn.FAP
```

V.5.44.2 Description

| Member Summary | |
|----------------|--------------------------|
| Fields | |
| int | <u>viseme</u> |
| int | <u>expression</u> |
| int | <u>open_jaw</u> |
| int | <u>lower_t_midlip</u> |
| int | <u>raise_b_midlip</u> |
| int | <u>stretch_l_corner</u> |
| int | <u>stretch_r_corner</u> |
| int | <u>lower_t_lip_lm</u> |
| int | <u>lower_t_lip_rm</u> |
| int | <u>lower_b_lip_lm</u> |
| int | <u>lower_b_lip_rm</u> |
| int | <u>raise_l_cornerlip</u> |
| int | <u>raise_r_cornerlip</u> |
| int | <u>thrust_jaw</u> |
| int | <u>shift_jaw</u> |
| int | <u>push_b_lip</u> |
| int | <u>push_t_lip</u> |
| int | <u>depress_chin</u> |
| int | <u>close_t_l_eyelid</u> |
| int | <u>close_t_r_eyelid</u> |
| int | <u>close_b_l_eyelid</u> |
| int | <u>close_b_r_eyelid</u> |
| int | <u>yaw_l_eyeball</u> |
| int | <u>yaw_r_eyeball</u> |
| int | <u>pitch_l_eyeball</u> |
| int | <u>pitch_r_eyeball</u> |
| int | <u>thrust_l_eyeball</u> |
| int | <u>thrust_r_eyeball</u> |
| int | <u>dilate_l_pupil</u> |
| int | <u>dilate_r_pupil</u> |
| int | <u>raise_l_i_eyebrow</u> |
| int | <u>raise_r_i_eyebrow</u> |
| int | <u>raise_l_m_eyebrow</u> |
| int | <u>raise_r_m_eyebrow</u> |
| int | <u>raise_l_o_eyebrow</u> |
| int | <u>raise_r_o_eyebrow</u> |
| int | <u>squeeze_l_eyebrow</u> |
| int | <u>squeeze_r_eyebrow</u> |
| int | <u>puff_l_cheek</u> |
| int | <u>puff_r_cheek</u> |
| int | <u>lift_l_cheek</u> |
| int | <u>lift_r_cheek</u> |
| int | <u>shift_tongue_tip</u> |
| int | <u>raise_tongue_tip</u> |
| int | <u>thrust_tongue_tip</u> |
| int | <u>raise_tongue</u> |

| | |
|-----|----------------------------|
| int | <u>tone舌 roll</u> |
| int | <u>head pitch</u> |
| int | <u>head yaw</u> |
| int | <u>head roll</u> |
| int | <u>lower t midlip o</u> |
| int | <u>raise b midlip o</u> |
| int | <u>stretch l cornerlip</u> |
| int | <u>stretch r cornerlip</u> |
| int | <u>lower t lip lm o</u> |
| int | <u>lower t lip rm o</u> |
| int | <u>raise b lip lm o</u> |
| int | <u>raise b lip rm o</u> |
| int | <u>raise l cornerlip o</u> |
| int | <u>raise r cornerlip o</u> |
| int | <u>stretch l nose</u> |
| int | <u>stretch r nose</u> |
| int | <u>raise nose</u> |
| int | <u>bend nose</u> |
| int | <u>raise l ear</u> |
| int | <u>raise r ear</u> |
| int | <u>pull l ear</u> |
| int | <u>pull r ear</u> |

V.5.44.3 Fields

bend_nose
 public static final int bend_nose
 bend_nose = 63

close_b_l_eyelid
 public static final int close_b_l_eyelid
 close_b_l_eyelid = 20

close_b_r_eyelid
 public static final int close_b_r_eyelid
 close_b_r_eyelid = 21

close_t_l_eyelid
 public static final int close_t_l_eyelid
 close_t_l_eyelid = 18

close_t_r_eyelid
 public static final int close_t_r_eyelid
 close_t_r_eyelid = 19

depress_chin
 public static final int depress_chin
 depress_chin = 17

dilate_l_pupil
 public static final int dilate_l_pupil
 dilate_l_pupil = 28

dilate_r_pupil
 public static final int dilate_r_pupil
 dilate_r_pupil = 29

expression
 public static final int expression
 expression = 1

head_pitch
 public static final int head_pitch
 head_pitch = 47

head_roll
 public static final int head_roll
 head_roll = 49

```

head_yaw
public static final int head_yaw
head_yaw = 48

lift_l_cheek
public static final int lift_l_cheek
lift_l_cheek = 40

lift_r_cheek
public static final int lift_r_cheek
lift_r_cheek = 41

lower_b_lip_lm
public static final int lower_b_lip_lm
lower_b_lip_lm = 9

lower_b_lip_rm
public static final int lower_b_lip_rm
lower_b_lip_rm = 10

lower_t_lip_lm
public static final int lower_t_lip_lm
lower_t_lm = 7

lower_t_lip_lm_o
public static final int lower_t_lip_lm_o
lower_t_lip_lm_o = 54

lower_t_lip_rm
public static final int lower_t_lip_rm
lower_t_lip_rm = 8

lower_t_lip_rm_o
public static final int lower_t_lip_rm_o
lower_t_lip_rm_o = 55

lower_t_midlip
public static final int lower_t_midlip
lower_t_midlip = 3

lower_t_midlip_o
public static final int lower_t_midlip_o
lower_t_midlip_o = 50

open_jaw
public static final int open_jaw
open_jaw = 2

pitch_l_eyeball
public static final int pitch_l_eyeball
pitch_l_eyeball = 24

pitch_r_eyeball
public static final int pitch_r_eyeball
pitch_r_eyeball = 25

puff_l_cheek
public static final int puff_l_cheek
puff_l_cheek = 38

puff_r_cheek
public static final int puff_r_cheek
puff_r_cheek = 39

pull_l_ear
public static final int pull_l_ear
pull_l_ear = 66

pull_r_ear

```

```

public static final int pull_r_ear
pull_r_ear = 67
push_b_lip
public static final int push_b_lip
push_b_lip = 15
push_t_lip
public static final int push_t_lip
push_t_lip = 16
raise_b_lip_lm_o
public static final int raise_b_lip_lm_o
raise_b_lip_lm_o = 56
raise_b_lip_rm_o
public static final int raise_b_lip_rm_o
raise_b_lip_rm_o = 57
raise_b_midlip
public static final int raise_b_midlip
raise_b_midlip = 4
raise_b_midlip_o
public static final int raise_b_midlip_o
raise_b_midlip_o = 51
raise_l_cornerlip
public static final int raise_l_cornerlip
raise_l_cornerlip = 11
raise_l_cornerlip_o
public static final int raise_l_cornerlip_o
raise_l_cornerlip_o = 58
raise_l_ear
public static final int raise_l_ear
raise_l_ear = 64
raise_l_i_eyebrow
public static final int raise_l_i_eyebrow
raise_l_i_eyebrow = 30
raise_l_m_eyebrow
public static final int raise_l_m_eyebrow
raise_l_m_eyebrow = 32
raise_l_o_eyebrow
public static final int raise_l_o_eyebrow
raise_l_o_eyebrow = 34
raise_nose
public static final int raise_nose
raise_nose = 62
raise_r_cornerlip
public static final int raise_r_cornerlip
raise_r_cornerlip = 12
raise_r_cornerlip_o
public static final int raise_r_cornerlip_o
raise_r_cornerlip_o = 59
raise_r_ear
public static final int raise_r_ear
raise_r_ear = 65
raise_r_i_eyebrow

```

```
public static final int raise_r_i_eyebrow
raise_r_i_eyebrow = 31
raise_r_m_eyebrow
public static final int raise_r_m_eyebrow
raise_r_m_eyebrow = 33
raise_r_o_eyebrow
public static final int raise_r_o_eyebrow
raise_r_o_eyebrow = 35
raise_tongue
public static final int raise_tongue
raise_tongue = 45
raise_tongue_tip
public static final int raise_tongue_tip
raise_tongue_tip = 43
shift_jaw
public static final int shift_jaw
shift_jaw = 14
shift_tongue_tip
public static final int shift_tongue_tip
shift_tongue_tip = 42
squeeze_l_eyebrow
public static final int squeeze_l_eyebrow
squeeze_l_eyebrow = 36
squeeze_r_eyebrow
public static final int squeeze_r_eyebrow
squeeze_r_eyebrow = 37
stretch_l_corner
public static final int stretch_l_corner
stretch_l_corner = 5
stretch_l_cornerlip
public static final int stretch_l_cornerlip
stretch_l_cornerlip = 52
stretch_l_nose
public static final int stretch_l_nose
stretch_l_nose = 60
stretch_r_corner
public static final int stretch_r_corner
stretch_r_corner = 6
stretch_r_cornerlip
public static final int stretch_r_cornerlip
stretch_r_cornerlip = 53
stretch_r_nose
public static final int stretch_r_nose
stretch_r_nose = 61
thrust_jaw
public static final int thrust_jaw
thrust_jaw = 13
thrust_l_eyeball
public static final int thrust_l_eyeball
thrust_l_eyeball = 26
thrust_r_eyeball
```

```

public static final int thrust_r_eyeball
thrust_r_eyeball = 27
thrust_tongue_tip
public static final int thrust_tongue_tip
thrust_tongue_tip = 44
tongue_roll
public static final int tongue_roll
tongue_roll = 46
viseme
public static final int viseme
viseme = 0
yaw_l_eyeball
public static final int yaw_l_eyeball
yaw_l_eyeball = 22
yaw_r_eyeball
public static final int yaw_r_eyeball
yaw_r_eyeball = 23

```

V.5.45 org.iso.mpeg.mpegj.scene.EventIn.FDP

V.5.45.1 Syntax

```
public static interface EventIn.FDP
```

V.5.45.2 Description

| Member Summary | |
|----------------|---|
| Fields | |
| int | <u>featurePointsCoord</u> |
| int | <u>textureCoord</u> |
| int | <u>faceDefTables</u> |
| int | <u>faceSceneGraph</u> |

V.5.45.3 Fields

```

faceDefTables
public static final int faceDefTables
faceDefTables = 2
faceSceneGraph
public static final int faceSceneGraph
faceSceneGraph = 3
featurePointsCoord
public static final int featurePointsCoord
featurePointsCoord = 0
textureCoord
public static final int textureCoord
textureCoord = 1

```

V.5.46 org.iso.mpeg.mpegj.scene.EventIn.FIT

V.5.46.1 Syntax

```
public static interface EventIn.FIT
```

V.5.46.2 Description

| Member Summary | |
|----------------|--|
| | |

| Fields | |
|--------|-------------------------|
| int | <u>FAPs</u> |
| int | <u>Graph</u> |
| int | <u>numeratorExp</u> |
| int | <u>denominatorExp</u> |
| int | <u>numeratorImpulse</u> |
| int | <u>numeratorTerms</u> |
| int | <u>denominatorTerms</u> |
| int | <u>numeratorCoefs</u> |
| int | <u>denominatorCoefs</u> |

V.5.46.3 Fields

denominatorCoefs

```
public static final int denominatorCoefs
```

denominatorCoefs = 8

denominatorExp

```
public static final int denominatorExp
```

denominatorExp = 3

denominatorTerms

```
public static final int denominatorTerms
```

denominatorTerms = 6

FAPs

```
public static final int FAPs
```

FAPs = 0

Graph

```
public static final int Graph
```

Graph = 1

numeratorCoefs

```
public static final int numeratorCoefs
```

numeratorCoefs = 7

numeratorExp

```
public static final int numeratorExp
```

numeratorExp = 2

numeratorImpulse

```
public static final int numeratorImpulse
```

numeratorImpulse = 4

numeratorTerms

```
public static final int numeratorTerms
```

numeratorTerms = 5

V.5.47 org.iso.mpeg.mpegj.scene.EventIn.Fog

V.5.47.1 Syntax

```
public static interface EventIn.Fog
```

V.5.47.2 Description

| Member Summary | |
|----------------|------------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>fogType</u> |
| int | <u>visibilityRange</u> |
| int | <u>set bind</u> |

V.5.47.3 Fields

```

color
public static final int color
color = 0

fogType
public static final int fogType
fogType = 1

set_bind
public static final int set_bind
set_bind = 3

visibilityRange
public static final int visibilityRange
visibilityRange = 2

```

V.5.48 org.iso.mpeg.mpegj.scene.EventIn.FontStyle

V.5.48.1 Syntax

```
public static interface EventIn.FontStyle
```

V.5.48.2 Description

V.5.49 org.iso.mpeg.mpegj.scene.EventIn.Form

V.5.49.1 Syntax

```
public static interface EventIn.Form
```

V.5.49.2 Description

| Member Summary | |
|----------------|--------------------------------|
| Fields | |
| int | addChildren |
| int | removeChildren |
| int | children |
| int | size |
| int | groups |
| int | constraints |
| int | groupsIndex |

V.5.49.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

children
public static final int children
children = 2

constraints
public static final int constraints
constraints = 5

groups
public static final int groups
groups = 4

groupsIndex
public static final int groupsIndex
groupsIndex = 6

```

removeChildren

```
public static final int removeChildren  
removeChildren = 1  
size  
public static final int size  
size = 3
```

V.5.50 org.iso.mpeg.mpegj.scene.EventIn.Group

V.5.50.1 Syntax

```
public static interface EventIn.Group
```

V.5.50.2 Description

| Member Summary | |
|----------------|---------------------------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |

V.5.50.3 Fields

addChildren

```
public static final int addChildren  
addChildren = 0
```

children

```
public static final int children  
children = 2
```

removeChildren

```
public static final int removeChildren  
removeChildren = 1
```

V.5.51 org.iso.mpeg.mpegj.scene.EventIn.ImageTexture

V.5.51.1 Syntax

```
public static interface EventIn.ImageTexture
```

V.5.51.2 Description

| Member Summary | |
|----------------|----------------------------|
| Fields | |
| int | <u>url</u> |

V.5.51.3 Fields

url

```
public static final int url  
url = 0
```

V.5.52 org.iso.mpeg.mpegj.scene.EventIn.IndexedFaceSet

V.5.52.1 Syntax

```
public static interface EventIn.IndexedFaceSet
```

V.5.52.2 Description

| Member Summary | |
|-----------------------|--------------------------|
| Fields | |
| int | <u>set_colorIndex</u> |
| int | <u>set_coordIndex</u> |
| int | <u>set_normalIndex</u> |
| int | <u>set_texCoordIndex</u> |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |

V.5.52.3 Fields

color
 public static final int color
 color = 4

coord
 public static final int coord
 coord = 5

normal
 public static final int normal
 normal = 6

set_colorIndex
 public static final int set_colorIndex
 set_colorIndex = 0

set_coordIndex
 public static final int set_coordIndex
 set_coordIndex = 1

set_normalIndex
 public static final int set_normalIndex
 set_normalIndex = 2

set_texCoordIndex
 public static final int set_texCoordIndex
 set_texCoordIndex = 3

texCoord
 public static final int texCoord
 texCoord = 7

V.5.53 org.iso.mpeg.mpegj.scene.EventIn.IndexedFaceSet2D

V.5.53.1 Syntax

```
public static interface EventIn.IndexedFaceSet2D
```

V.5.53.2 Description

| Member Summary | |
|-----------------------|--------------------------|
| Fields | |
| int | <u>set_colorIndex</u> |
| int | <u>set_coordIndex</u> |
| int | <u>set_texCoordIndex</u> |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>texCoord</u> |

V.5.53.3 Fields

color
 public static final int color

```

color = 3
coord
public static final int coord
coord = 4
set_colorIndex
public static final int set_colorIndex
set_colorIndex = 0
set_coordIndex
public static final int set_coordIndex
set_coordIndex = 1
set_texCoordIndex
public static final int set_texCoordIndex
set_texCoordIndex = 2
texCoord
public static final int texCoord
texCoord = 5

```

V.5.54 org.iso.mpeg.mpegj.scene.EventIn.IndexedLineSet**V.5.54.1 Syntax**

```
public static interface EventIn.IndexedLineSet
```

V.5.54.2 Description

| Member Summary | |
|----------------|-----------------------|
| Fields | |
| int | <u>set_colorIndex</u> |
| int | <u>set_coordIndex</u> |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.54.3 Fields

```

color
public static final int color
color = 2
coord
public static final int coord
coord = 3
set_colorIndex
public static final int set_colorIndex
set_colorIndex = 0
set_coordIndex
public static final int set_coordIndex
set_coordIndex = 1

```

V.5.55 org.iso.mpeg.mpegj.scene.EventIn.IndexedLineSet2D**V.5.55.1 Syntax**

```
public static interface EventIn.IndexedLineSet2D
```

V.5.55.2 Description

| Member Summary | |
|----------------|--|
| Fields | |

| | |
|-----|-----------------------|
| int | <u>set_colorIndex</u> |
| int | <u>set_coordIndex</u> |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.55.3 Fields

color
 public static final int color
 color = 2

coord
 public static final int coord
 coord = 3

set_colorIndex
 public static final int set_colorIndex
 set_colorIndex = 0

set_coordIndex
 public static final int set_coordIndex
 set_coordIndex = 1

V.5.56 org.iso.mpeg.mpegj.scene.EventIn_INLINE

V.5.56.1 Syntax

```
public static interface EventIn_INLINE
```

V.5.56.2 Description

| Member Summary | | | |
|----------------|---|-----|------------|
| Fields | <table border="1"> <tr> <td>int</td> <td><u>url</u></td> </tr> </table> | int | <u>url</u> |
| int | <u>url</u> | | |

V.5.56.3 Fields

url
 public static final int url
 url = 0

V.5.57 org.iso.mpeg.mpegj.scene.EventIn_LAYER2D

V.5.57.1 Syntax

```
public static interface EventIn_LAYER2D
```

V.5.57.2 Description

| Member Summary | | | | | | | | | | | | | |
|----------------|--|-----|--------------------|-----|-----------------------|-----|-----------------|-----|-------------|-----|-------------------|-----|-----------------|
| Fields | <table border="1"> <tr> <td>int</td> <td><u>addChildren</u></td> </tr> <tr> <td>int</td> <td><u>removeChildren</u></td> </tr> <tr> <td>int</td> <td><u>children</u></td> </tr> <tr> <td>int</td> <td><u>size</u></td> </tr> <tr> <td>int</td> <td><u>background</u></td> </tr> <tr> <td>int</td> <td><u>viewport</u></td> </tr> </table> | int | <u>addChildren</u> | int | <u>removeChildren</u> | int | <u>children</u> | int | <u>size</u> | int | <u>background</u> | int | <u>viewport</u> |
| int | <u>addChildren</u> | | | | | | | | | | | | |
| int | <u>removeChildren</u> | | | | | | | | | | | | |
| int | <u>children</u> | | | | | | | | | | | | |
| int | <u>size</u> | | | | | | | | | | | | |
| int | <u>background</u> | | | | | | | | | | | | |
| int | <u>viewport</u> | | | | | | | | | | | | |

V.5.57.3 Fields

addChildren
 public static final int addChildren
 addChildren = 0

```

background
public static final int background
background = 4

children
public static final int children
children = 2

removeChildren
public static final int removeChildren
removeChildren = 1

size
public static final int size
size = 3

viewport
public static final int viewport
viewport = 5

```

V.5.58 org.iso.mpeg.mpegj.scene.EventIn.Layer3D

V.5.58.1 Syntax

```
public static interface EventIn.Layer3D
```

V.5.58.2 Description

| Member Summary | |
|-----------------------|---------------------------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>size</u> |
| int | <u>background</u> |
| int | <u>fog</u> |
| int | <u>navigationInfo</u> |
| int | <u>viewpoint</u> |

V.5.58.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

background
public static final int background
background = 4

children
public static final int children
children = 2

fog
public static final int fog
fog = 5

navigationInfo
public static final int navigationInfo
navigationInfo = 6

removeChildren
public static final int removeChildren
removeChildren = 1

size

```

```

public static final int size
size = 3
viewpoint
public static final int viewpoint
viewpoint = 7

```

V.5.59 org.iso.mpeg.mpegj.scene.EventIn.Layout

V.5.59.1 Syntax

```
public static interface EventIn.Layout
```

V.5.59.2 Description

| Member Summary | |
|-----------------------|---------------------------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>wrap</u> |
| int | <u>size</u> |
| int | <u>horizontal</u> |
| int | <u>justify</u> |
| int | <u>leftToRight</u> |
| int | <u>topToBottom</u> |
| int | <u>spacing</u> |
| int | <u>smoothScroll</u> |
| int | <u>loop</u> |
| int | <u>scrollVertical</u> |
| int | <u>scrollRate</u> |

V.5.59.3 Fields

addChildren

```

public static final int addChildren
addChildren = 0

```

children

```

public static final int children
children = 2

```

horizontal

```

public static final int horizontal
horizontal = 5

```

justify

```

public static final int justify
justify = 6

```

leftToRight

```

public static final int leftToRight
leftToRight = 7

```

loop

```

public static final int loop
loop = 11

```

removeChildren

```

public static final int removeChildren
removeChildren = 1

```

scrollRate

```

public static final int scrollRate
scrollRate = 13

```

scrollVertical

```
public static final int scrollVertical
scrollVertical = 12
size
public static final int size
size = 4
smoothScroll
public static final int smoothScroll
smoothScroll = 10
spacing
public static final int spacing
spacing = 9
topToBottom
public static final int topToBottom
topToBottom = 8
wrap
public static final int wrap
wrap = 3
```

V.5.60 org.iso.mpeg.mpegj.scene.EventIn.LineProperties

V.5.60.1 Syntax

```
public static interface EventIn.LineProperties
```

V.5.60.2 Description

| Member Summary | | |
|----------------|------------------|--|
| Fields | | |
| int | <u>lineColor</u> | |
| int | <u>lineStyle</u> | |
| int | <u>width</u> | |

V.5.60.3 Fields

```
lineColor
public static final int lineColor
lineColor = 0
lineStyle
public static final int lineStyle
lineStyle = 1
width
public static final int width
width = 2
```

V.5.61 org.iso.mpeg.mpegj.scene.EventIn.ListeningPoint

V.5.61.1 Syntax

```
public static interface EventIn.ListeningPoint
```

V.5.61.2 Description

| Member Summary | | |
|----------------|--------------------|--|
| Fields | | |
| int | <u>set_bind</u> | |
| int | <u>jump</u> | |
| int | <u>orientation</u> | |
| int | <u>position</u> | |

V.5.61.3 Fields

```
jump
public static final int jump
jump = 1

orientation
public static final int orientation
orientation = 2

position
public static final int position
position = 3

set_bind
public static final int set_bind
set_bind = 0
```

V.5.62 org.iso.mpeg.mpegj.scene.EventIn.LOD

V.5.62.1 Syntax

```
public static interface EventIn.LOD
```

V.5.62.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | int <u>level</u> |

V.5.62.3 Fields

```
level
public static final int level
level = 0
```

V.5.63 org.iso.mpeg.mpegj.scene.EventIn.Material

V.5.63.1 Syntax

```
public static interface EventIn.Material
```

V.5.63.2 Description

| Member Summary | |
|-----------------------|---|
| Fields | int <u>ambientIntensity</u> int <u>diffuseColor</u> int <u>emissiveColor</u> int <u>shininess</u> int <u>specularColor</u> int <u>transparency</u> |

V.5.63.3 Fields

```
ambientIntensity
public static final int ambientIntensity
ambientIntensity = 0

diffuseColor
public static final int diffuseColor
diffuseColor = 1

emissiveColor
```

```
public static final int emissiveColor  
emissiveColor = 2  
shininess  
public static final int shininess  
shininess = 3  
specularColor  
public static final int specularColor  
specularColor = 4  
transparency  
public static final int transparency  
transparency = 5
```

V.5.64 org.iso.mpeg.mpegj.scene.EventIn.Material2D

V.5.64.1 Syntax

```
public static interface EventIn.Material2D
```

V.5.64.2 Description

| Member Summary | |
|----------------|----------------------|
| Fields | |
| int | <u>emissiveColor</u> |
| int | <u>filled</u> |
| int | <u>lineProps</u> |
| int | <u>transparency</u> |

V.5.64.3 Fields

```
emissiveColor  
public static final int emissiveColor  
emissiveColor = 0  
filled  
public static final int filled  
filled = 1  
lineProps  
public static final int lineProps  
lineProps = 2  
transparency  
public static final int transparency  
transparency = 3
```

V.5.65 org.iso.mpeg.mpegj.scene.EventIn.MovieTexture

V.5.65.1 Syntax

```
public static interface EventIn.MovieTexture
```

V.5.65.2 Description

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |

V.5.65.3 Fields

```

loop
public static final int loop
loop = 0

speed
public static final int speed
speed = 1

startTime
public static final int startTime
startTime = 2

stopTime
public static final int stopTime
stopTime = 3

url
public static final int url
url = 4

```

V.5.66 org.iso.mpeg.mpegj.scene.EventIn.NavigationInfo

V.5.66.1 Syntax

```
public static interface EventIn.NavigationInfo
```

V.5.66.2 Description

| Member Summary | |
|-----------------------|--|
| Fields | |
| int | <u>set_bind</u> |
| int | <u>avatarSize</u> |
| int | <u>headlight</u> |
| int | <u>speed</u> |
| int | <u>type</u> |
| int | <u>visibilityLimit</u> |

V.5.66.3 Fields

```

avatarSize
public static final int avatarSize
avatarSize = 1

headlight
public static final int headlight
headlight = 2

set_bind
public static final int set_bind
set_bind = 0

speed
public static final int speed
speed = 3

type
public static final int type
type = 4

visibilityLimit
public static final int visibilityLimit
visibilityLimit = 5

```

V.5.67 org.iso.mpeg.mpegj.scene.EventIn.Normal**V.5.67.1 Syntax**

```
public static interface EventIn.Normal
```

V.5.67.2 Description

| Member Summary | |
|----------------|---------------|
| Fields | |
| int | <u>vector</u> |

V.5.67.3 Fields

vector
 public static final int vector
 vector = 0

V.5.68 org.iso.mpeg.mpegj.scene.EventIn.NormalInterpolator**V.5.68.1 Syntax**

```
public static interface EventIn.NormalInterpolator
```

V.5.68.2 Description

| Member Summary | |
|----------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.68.3 Fields

key
 public static final int key
 key = 1

keyValue
 public static final int keyValue
 keyValue = 2

set_fraction
 public static final int set_fraction
 set_fraction = 0

V.5.69 org.iso.mpeg.mpegj.scene.EventIn.OrderedGroup**V.5.69.1 Syntax**

```
public static interface EventIn.OrderedGroup
```

V.5.69.2 Description

| Member Summary | |
|----------------|-----------------------|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>order</u> |

V.5.69.3 Fields

addChildren

```

public static final int addChildren
addChildren = 0
children
public static final int children
children = 2
order
public static final int order
order = 3
removeChildren
public static final int removeChildren
removeChildren = 1

```

V.5.70 org.iso.mpeg.mpegj.scene.EventIn.OrientationInterpolator

V.5.70.1 Syntax

```
public static interface EventIn.OrientationInterpolator
```

V.5.70.2 Description

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.70.3 Fields

```

key
public static final int key
key = 1
keyValue
public static final int keyValue
keyValue = 2
set_fraction
public static final int set_fraction
set_fraction = 0

```

V.5.71 org.iso.mpeg.mpegj.scene.EventIn.PixelTexture

V.5.71.1 Syntax

```
public static interface EventIn.PixelTexture
```

V.5.71.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>image</u> |

V.5.71.3 Fields

```

image
public static final int image
image = 0

```

V.5.72 org.iso.mpeg.mpegj.scene.EventIn.PlaneSensor**V.5.72.1 Syntax**

```
public static interface EventIn.PlaneSensor
```

V.5.72.2 Description

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |

V.5.72.3 Fields**autoOffset**

```
public static final int autoOffset
```

autoOffset = 0

enabled

```
public static final int enabled
```

enabled = 1

maxPosition

```
public static final int maxPosition
```

maxPosition = 2

minPosition

```
public static final int minPosition
```

minPosition = 3

offset

```
public static final int offset
```

offset = 4

V.5.73 org.iso.mpeg.mpegj.scene.EventIn.PlaneSensor2D**V.5.73.1 Syntax**

```
public static interface EventIn.PlaneSensor2D
```

V.5.73.2 Description

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |

V.5.73.3 Fields**autoOffset**

```
public static final int autoOffset
```

autoOffset = 0

enabled

```
public static final int enabled
```

enabled = 1

maxPosition

```

public static final int maxPosition
maxPosition = 2
minPosition
public static final int minPosition
minPosition = 3
offset
public static final int offset
offset = 4

```

V.5.74 org.iso.mpeg.mpegj.scene.EventIn.PointLight

V.5.74.1 Syntax

```
public static interface EventIn.PointLight
```

V.5.74.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>color</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.74.3 Fields

ambientIntensity

```
public static final int ambientIntensity
```

```
ambientIntensity = 0
```

attenuation

```
public static final int attenuation
```

```
attenuation = 1
```

color

```
public static final int color
```

```
color = 2
```

intensity

```
public static final int intensity
```

```
intensity = 3
```

location

```
public static final int location
```

```
location = 4
```

on

```
public static final int on
```

```
on = 5
```

radius

```
public static final int radius
```

```
radius = 6
```

V.5.75 org.iso.mpeg.mpegj.scene.EventIn.PointSet

V.5.75.1 Syntax

```
public static interface EventIn.PointSet
```

V.5.75.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.75.3 Fields

color
 public static final int color
 color = 0

coord
 public static final int coord
 coord = 1

V.5.76 org.iso.mpeg.mpegj.scene.EventIn.PointSet2D

V.5.76.1 Syntax

```
public static interface EventIn.PointSet2D
```

V.5.76.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.76.3 Fields

color
 public static final int color
 color = 0

coord
 public static final int coord
 coord = 1

V.5.77 org.iso.mpeg.mpegj.scene.EventIn.PositionInterpolator

V.5.77.1 Syntax

```
public static interface EventIn.PositionInterpolator
```

V.5.77.2 Description

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.77.3 Fields

key
 public static final int key
 key = 1

keyValue
 public static final int keyValue

```

keyValue = 2
set_fraction
public static final int set_fraction
set_fraction = 0

```

V.5.78 org.iso.mpeg.mpegj.scene.EventIn.PositionInterpolator2D

V.5.78.1 Syntax

```
public static interface EventIn.PositionInterpolator2D
```

V.5.78.2 Description

| Member Summary | |
|----------------|---------------------|
| Fields | |
| int | <u>set_fraction</u> |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.78.3 Fields

```

key
public static final int key
key = 1
keyValue
public static final int keyValue
keyValue = 2
set_fraction
public static final int set_fraction
set_fraction = 0

```

V.5.79 org.iso.mpeg.mpegj.scene.EventIn.ProximitySensor

V.5.79.1 Syntax

```
public static interface EventIn.ProximitySensor
```

V.5.79.2 Description

| Member Summary | |
|----------------|----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |

V.5.79.3 Fields

```

center
public static final int center
center = 0
enabled
public static final int enabled
enabled = 2
size
public static final int size
size = 1

```

V.5.80 org.iso.mpeg.mpegj.scene.EventIn.ProximitySensor2D**V.5.80.1 Syntax**

```
public static interface EventIn.ProximitySensor2D
```

V.5.80.2 Description

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |

V.5.80.3 Fields**center**

```
public static final int center
```

```
center = 0
```

enabled

```
public static final int enabled
```

```
enabled = 2
```

size

```
public static final int size
```

```
size = 1
```

V.5.81 org.iso.mpeg.mpegj.scene.EventIn.QuantizationParameter**V.5.81.1 Syntax**

```
public static interface EventIn.QuantizationParameter
```

V.5.81.2 Description**V.5.82 org.iso.mpeg.mpegj.scene.EventIn.Rectangle****V.5.82.1 Syntax**

```
public static interface EventIn.Rectangle
```

V.5.82.2 Description

| Member Summary | |
|-----------------------|-------------|
| Fields | |
| int | <u>size</u> |

V.5.82.3 Fields**size**

```
public static final int size
```

```
size = 0
```

V.5.83 org.iso.mpeg.mpegj.scene.EventIn.ScalarInterpolator**V.5.83.1 Syntax**

```
public static interface EventIn.ScalarInterpolator
```

V.5.83.2 Description

| Member Summary |
|-----------------------|
|-----------------------|

| Fields | | |
|--------|--|---------------------|
| int | | <u>set_fraction</u> |
| int | | <u>key</u> |
| int | | <u>keyValue</u> |

V.5.83.3 Fields

key
 public static final int key
 key = 1

keyValue
 public static final int keyValue
 keyValue = 2

set_fraction
 public static final int set_fraction
 set_fraction = 0

V.5.84 org.iso.mpeg.mpegj.scene.EventIn.Script

V.5.84.1 Syntax

```
public static interface EventIn.Script
```

V.5.84.2 Description

| Member Summary | | |
|----------------|--|------------|
| Fields | | |
| int | | <u>url</u> |

V.5.84.3 Fields

url
 public static final int url
 url = 0

V.5.85 org.iso.mpeg.mpegj.scene.EventIn.Shape

V.5.85.1 Syntax

```
public static interface EventIn.Shape
```

V.5.85.2 Description

| Member Summary | | |
|----------------|--|-------------------|
| Fields | | |
| int | | <u>appearance</u> |
| int | | <u>geometry</u> |

V.5.85.3 Fields

appearance
 public static final int appearance
 appearance = 0

geometry
 public static final int geometry
 geometry = 1

V.5.86 org.iso.mpeg.mpegj.scene.EventIn.Sound**V.5.86.1 Syntax**

```
public static interface EventIn.Sound
```

V.5.86.2 Description

| Member Summary | |
|-----------------------|----------------------------------|
| Fields | |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>maxBack</u> |
| int | <u>maxFront</u> |
| int | <u>minBack</u> |
| int | <u>minFront</u> |
| int | <u>priority</u> |
| int | <u>source</u> |

V.5.86.3 Fields**direction**

```
public static final int direction
```

```
direction = 0
```

intensity

```
public static final int intensity
```

```
intensity = 1
```

location

```
public static final int location
```

```
location = 2
```

maxBack

```
public static final int maxBack
```

```
maxBack = 3
```

maxFront

```
public static final int maxFront
```

```
maxFront = 4
```

minBack

```
public static final int minBack
```

```
minBack = 5
```

minFront

```
public static final int minFront
```

```
minFront = 6
```

priority

```
public static final int priority
```

```
priority = 7
```

source

```
public static final int source
```

```
source = 8
```

V.5.87 org.iso.mpeg.mpegj.scene.EventIn.Sound2D**V.5.87.1 Syntax**

```
public static interface EventIn.Sound2D
```

V.5.87.2 Description

| Member Summary | |
|-----------------------|--|
| | |

| Fields | | |
|--------|------------------|--|
| int | <u>intensity</u> | |
| int | <u>location</u> | |
| int | <u>source</u> | |

V.5.87.3 Fields

intensity

```
public static final int intensity
```

intensity = 0

location

```
public static final int location
```

location = 1

source

```
public static final int source
```

source = 2

V.5.88 org.iso.mpeg.mpegj.scene.EventIn.Sphere

V.5.88.1 Syntax

```
public static interface EventIn.Sphere
```

V.5.88.2 Description

V.5.89 org.iso.mpeg.mpegj.scene.EventIn.SphereSensor

V.5.89.1 Syntax

```
public static interface EventIn.SphereSensor
```

V.5.89.2 Description

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>offset</u> |

V.5.89.3 Fields

autoOffset

```
public static final int autoOffset
```

autoOffset = 0

enabled

```
public static final int enabled
```

enabled = 1

offset

```
public static final int offset
```

offset = 2

V.5.90 org.iso.mpeg.mpegj.scene.EventIn.SpotLight

V.5.90.1 Syntax

```
public static interface EventIn.SpotLight
```

V.5.90.2 Description

| Member Summary | |
|----------------|--|
|----------------|--|

| Fields | |
|--------|-------------------------|
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>beamWidth</u> |
| int | <u>color</u> |
| int | <u>cutOffAngle</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.90.3 Fields

ambientIntensity
 public static final int ambientIntensity
 ambientIntensity = 0

attenuation
 public static final int attenuation
 attenuation = 1

beamWidth
 public static final int beamWidth
 beamWidth = 2

color
 public static final int color
 color = 3

cutOffAngle
 public static final int cutOffAngle
 cutOffAngle = 4

direction
 public static final int direction
 direction = 5

intensity
 public static final int intensity
 intensity = 6

location
 public static final int location
 location = 7

on
 public static final int on
 on = 8

radius
 public static final int radius
 radius = 9

V.5.91 org.iso.mpeg.mpegj.scene.EventIn.Switch

V.5.91.1 Syntax

```
public static interface EventIn.Switch
```

V.5.91.2 Description

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>choice</u> |
| int | <u>whichChoice</u> |

V.5.91.3 Fields

choice

public static final int choice

choice = 0

whichChoice

public static final int whichChoice

whichChoice = 1

V.5.92 org.iso.mpeg.mpegj.scene.EventIn.TermCap

V.5.92.1 Syntax

public static interface EventIn.TermCap

V.5.92.2 Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>evaluate</u> |
| int | <u>capability</u> |

V.5.92.3 Fields

capability

public static final int capability

capability = 1

evaluate

public static final int evaluate

evaluate = 0

V.5.93 org.iso.mpeg.mpegj.scene.EventIn.Text

V.5.93.1 Syntax

public static interface EventIn.Text

V.5.93.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>string</u> |
| int | <u>length</u> |
| int | <u>fontStyle</u> |
| int | <u>maxExtent</u> |

V.5.93.3 Fields

fontStyle

public static final int fontStyle

fontStyle = 2

length

public static final int length

length = 1

maxExtent

public static final int maxExtent

maxExtent = 3

string

public static final int string

string = 0

V.5.94 org.iso.mpeg.mpegj.scene.EventIn.TextureCoordinate**V.5.94.1 Syntax**

```
public static interface EventIn.TextureCoordinate
```

V.5.94.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.94.3 Fields

point
 public static final int point
 point = 0

V.5.95 org.iso.mpeg.mpegj.scene.EventIn.TextureTransform**V.5.95.1 Syntax**

```
public static interface EventIn.TextureTransform
```

V.5.95.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>rotation</u> |
| int | <u>scale</u> |
| int | <u>translation</u> |

V.5.95.3 Fields

center
 public static final int center
 center = 0

rotation
 public static final int rotation
 rotation = 1

scale
 public static final int scale
 scale = 2

translation
 public static final int translation
 translation = 3

V.5.96 org.iso.mpeg.mpegj.scene.EventIn.TimeSensor**V.5.96.1 Syntax**

```
public static interface EventIn.TimeSensor
```

V.5.96.2 Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>cycleInterval</u> |
| int | <u>enabled</u> |
| int | <u>loop</u> |

| | |
|-----|------------------|
| int | <u>startTime</u> |
| int | <u>stopTime</u> |

V.5.96.3 Fields

cycleInterval
 public static final int cycleInterval
 cycleInterval = 0

enabled
 public static final int enabled
 enabled = 1

loop
 public static final int loop
 loop = 2

startTime
 public static final int startTime
 startTime = 3

stopTime
 public static final int stopTime
 stopTime = 4

V.5.97 org.iso.mpeg.mpegj.scene.EventIn.TouchSensor

V.5.97.1 Syntax

```
public static interface EventIn.TouchSensor
```

V.5.97.2 Description

| Member Summary | |
|----------------|--------------------|
| Fields | int <u>enabled</u> |

V.5.97.3 Fields

enabled
 public static final int enabled
 enabled = 0

V.5.98 org.iso.mpeg.mpegj.scene.EventIn.Transform

V.5.98.1 Syntax

```
public static interface EventIn.Transform
```

V.5.98.2 Description

| Member Summary | |
|----------------|---|
| Fields | int <u>addChildren</u> int <u>removeChildren</u> int <u>center</u> int <u>children</u> int <u>rotation</u> int <u>scale</u> int <u>scaleOrientation</u> int <u>translation</u> |

V.5.98.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

center
public static final int center
center = 2

children
public static final int children
children = 3

removeChildren
public static final int removeChildren
removeChildren = 1

rotation
public static final int rotation
rotation = 4

scale
public static final int scale
scale = 5

scaleOrientation
public static final int scaleOrientation
scaleOrientation = 6

translation
public static final int translation
translation = 7

```

V.5.99 org.iso.mpeg.mpegj.scene.EventIn.Transform2D**V.5.99.1 Syntax**

```
public static interface EventIn.Transform2D
```

V.5.99.2 Description

| Member Summary | |
|-----------------------|---|
| Fields | |
| int | <u>addChildren</u> |
| int | <u>removeChildren</u> |
| int | <u>children</u> |
| int | <u>center</u> |
| int | <u>rotationAngle</u> |
| int | <u>scale</u> |
| int | <u>scaleOrientation</u> |
| int | <u>translation</u> |

V.5.99.3 Fields

```

addChildren
public static final int addChildren
addChildren = 0

center
public static final int center
center = 3

children
public static final int children

```

```

children = 2
removeChildren
public static final int removeChildren
removeChildren = 1
rotationAngle
public static final int rotationAngle
rotationAngle = 4
scale
public static final int scale
scale = 5
scaleOrientation
public static final int scaleOrientation
scaleOrientation = 6
translation
public static final int translation
translation = 7

```

V.5.100 org.iso.mpeg.mpegj.scene.EventIn.Valuator

V.5.100.1 Syntax

```
public static interface EventIn.Valuator
```

V.5.100.2 Description

| Member Summary | |
|-----------------------|--|
| Fields | int <u>inSFBool</u> int <u>inSFCOLOR</u> int <u>inMFColor</u> int <u>inSFFloat</u> int <u>inMFFloat</u> int <u>inSFInt32</u> int <u>inMFInt32</u> int <u>inSFRotation</u> int <u>inMFRotation</u> int <u>inSFString</u> int <u>inMFString</u> int <u>inSFTime</u> int <u>inSFVec2f</u> int <u>inMFVec2f</u> int <u>inSFVec3f</u> int <u>inMFVec3f</u> int <u>Factor1</u> int <u>Factor2</u> int <u>Factor3</u> int <u>Factor4</u> int <u>Offset1</u> int <u>Offset2</u> int <u>Offset3</u> int <u>Offset4</u> int <u>Sum</u> |

V.5.100.3 Fields

Factor1

```
public static final int Factor1
```

Factor1 = 16

Factor2

```
public static final int Factor2
```

Factor2 = 17

Factor3

```
public static final int Factor3
```

```
Factor3 = 18
```

Factor4

```
public static final int Factor4
```

```
Factor4 = 19
```

inMFColor

```
public static final int inMFColor
```

```
inMFColor = 2
```

inMFFloat

```
public static final int inMFFloat
```

```
inMFFloat = 4
```

inMFInt32

```
public static final int inMFInt32
```

```
inMFInt32 = 6
```

inMFRotation

```
public static final int inMFRotation
```

```
inMFRotation = 8
```

inMFString

```
public static final int inMFString
```

```
inMFString = 10
```

inMFVec2f

```
public static final int inMFVec2f
```

```
inMFVec2f = 13
```

inMFVec3f

```
public static final int inMFVec3f
```

```
inMFVec3f = 15
```

inSFBool

```
public static final int inSFBool
```

```
inSFBool = 0
```

inSFCOLOR

```
public static final int inSFCOLOR
```

```
inSFCOLOR = 1
```

inSFFloat

```
public static final int inSFFloat
```

```
inSFFloat = 3
```

inSFInt32

```
public static final int inSFInt32
```

```
inSFInt32 = 5
```

inSFRotation

```
public static final int inSFRotation
```

```
inSFRotation = 7
```

inSFString

```
public static final int inSFString
```

```
inSFString = 9
```

inSFTime

```
public static final int inSFTime
```

```
inSFTime = 11
```

inSFVec2f

```
public static final int inSFVec2f
```

```
inSFVec2f = 12
```

```

inSFVec3f
public static final int inSFVec3f
inSFVec3f = 14

Offset1
public static final int Offset1
Offset1 = 20

Offset2
public static final int Offset2
Offset2 = 21

Offset3
public static final int Offset3
Offset3 = 22

Offset4
public static final int Offset4
Offset4 = 23

Sum
public static final int Sum
Sum = 24

```

V.5.101 org.iso.mpeg.mpegj.scene.EventIn.Viewpoint

V.5.101.1 Syntax

```
public static interface EventIn.Viewpoint
```

V.5.101.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>set_bind</u> |
| int | <u>fieldOfView</u> |
| int | <u>jump</u> |
| int | <u>orientation</u> |
| int | <u>position</u> |

V.5.101.3 Fields

```

fieldOfView
public static final int fieldOfView
fieldOfView = 1

jump
public static final int jump
jump = 2

orientation
public static final int orientation
orientation = 3

position
public static final int position
position = 4

set_bind
public static final int set_bind
set_bind = 0

```

V.5.102 org.iso.mpeg.mpegj.scene.EventIn.Viseme**V.5.102.1 Syntax**

```
public static interface EventIn.Viseme
```

V.5.102.2 Description

| Member Summary | |
|----------------|-----------------------|
| Fields | |
| int | <u>viseme_select1</u> |
| int | <u>viseme_select2</u> |
| int | <u>viseme_blend</u> |
| int | <u>viseme_def</u> |

V.5.102.3 Fields

viseme_blend
 public static final int viseme_blend
 viseme_blend = 2

viseme_def
 public static final int viseme_def
 viseme_def = 3

viseme_select1
 public static final int viseme_select1
 viseme_select1 = 0

viseme_select2
 public static final int viseme_select2
 viseme_select2 = 1

V.5.103 org.iso.mpeg.mpegj.scene.EventIn.VisibilitySensor**V.5.103.1 Syntax**

```
public static interface EventIn.VisibilitySensor
```

V.5.103.2 Description

| Member Summary | |
|----------------|----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>enabled</u> |
| int | <u>size</u> |

V.5.103.3 Fields

center
 public static final int center
 center = 0

enabled
 public static final int enabled
 enabled = 1

size
 public static final int size
 size = 2

V.5.104 org.iso.mpeg.mpegj.scene.EventIn.WorldInfo**V.5.104.1 Syntax**

```
public static interface EventIn.WorldInfo
```

V.5.104.2Description**V.5.105 org.iso.mpeg.mpegj.scene.EventOut****V.5.105.1 Syntax**

```
public interface EventOut
```

V.5.105.2Description

| Member Summary | |
|-----------------------|--|
| Inner Classes | <pre>static interface EventOut.Anchor static interface EventOut.AnimationStream static interface EventOut.Appearance static interface EventOut.AudioBuffer static interface EventOut.AudioClip static interface EventOut.AudioDelay static interface EventOut.AudioFX static interface EventOut.AudioMix static interface EventOut<audiosource> static interface EventOut.AudioSwitch static interface EventOut.Background static interface EventOut.Background2D static interface EventOut.Billboard static interface EventOut.Bitmap static interface EventOut.Box static interface EventOut.Circle static interface EventOut.Collision static interface EventOut.Color static interface EventOut.ColorInterpolator static interface EventOut.CompositeTexture2D static interface EventOut.CompositeTexture3D static interface EventOut.Conditional static interface EventOut.Cone static interface EventOut.Coordinate static interface EventOut.Coordinate2D static interface EventOut.CoordinateInterpolator static interface EventOut.CoordinateInterpolator2D static interface EventOut.Curve2D static interface EventOut.Cylinder static interface EventOut.CylinderSensor static interface EventOut.DirectionalLight static interface EventOut.DiscSensor static interface EventOut.ElevationGrid static interface EventOut.Expression static interface EventOut.Extrusion static interface EventOut.Face static interface EventOut.FaceDefMesh static interface EventOut.FaceDefTables static interface EventOut.FaceDefTransform static interface EventOut.FAP static interface EventOut.FDP static interface EventOut.FIT static interface EventOut.Fog static interface EventOut.FontStyle static interface EventOut.Form static interface EventOut.Group static interface EventOut.ImageTexture static interface EventOut.IndexedFaceSet static interface EventOut.IndexedFaceSet2D static interface EventOut.IndexedLineSet static interface EventOut.IndexedLineSet2D static interface EventOut.Inline static interface EventOut.LOD static interface EventOut.Layer2D static interface EventOut.Layer3D static interface EventOut.Layout static interface EventOut.LineProperties static interface EventOut.ListeningPoint static interface EventOut.Material</audiosource></pre> |

```

static interface EventOut.Material2D
static interface EventOut.MovieTexture
static interface EventOut.NavigationInfo
static interface EventOut.Normal
static interface EventOut.NormalInterpolator
static interface EventOut.OrderedGroup
static interface EventOut.OrientationInterpolator
static interface EventOut.PixelTexture
static interface EventOut.PlaneSensor
static interface EventOut.PlaneSensor2D
static interface EventOut.PointLight
static interface EventOut.PointSet
static interface EventOut.PointSet2D
static interface EventOut.PositionInterpolator
static interface EventOut.PositionInterpolator2D
static interface EventOut.ProximitySensor2D
static interface EventOut.ProximitySensor
static interface EventOut.QuantizationParameter
static interface EventOut.Rectangle
static interface EventOut.ScalarInterpolator
static interface EventOut.Script
static interface EventOut.Shape
static interface EventOut.Sound
static interface EventOut.Sound2D
static interface EventOut.Sphere
static interface EventOut.SphereSensor
static interface EventOut.SpotLight
static interface EventOut.Switch
static interface EventOut.TermCap
static interface EventOut.Text
static interface EventOut.TextureCoordinate
static interface EventOut.TextureTransform
static interface EventOut.TimeSensor
static interface EventOut.TouchSensor
static interface EventOut.Transform
static interface EventOut.Transform2D
static interface EventOut.Valuator
static interface EventOut.Viewpoint
static interface EventOut.VisibilitySensor
static interface EventOut.Viseme
static interface EventOut.WorldInfo

```

V.5.106 org.iso.mpeg.mpegj.scene.EventOut.Anchor

V.5.106.1 Syntax

```
public static interface EventOut.Anchor
```

V.5.106.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>description</u> |
| int | <u>parameter</u> |
| int | <u>url</u> |

V.5.106.3 Fields

children

```
public static final int children
```

```
children = 0
```

description

```
public static final int description
```

```
description = 1
```

parameter

```
public static final int parameter
```

```
parameter = 2
url
public static final int url
url = 3
```

V.5.107 org.iso.mpeg.mpegj.scene.EventOut.AnimationStream**V.5.107.1 Syntax**

```
public static interface EventOut.AnimationStream
```

V.5.107.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |
| int | <u>duration_changed</u> |
| int | <u>isActive</u> |

V.5.107.3 Fields**duration_changed**

```
public static final int duration_changed
```

```
duration_changed = 5
```

isActive

```
public static final int isActive
```

```
isActive = 6
```

loop

```
public static final int loop
```

```
loop = 0
```

speed

```
public static final int speed
```

```
speed = 1
```

startTime

```
public static final int startTime
```

```
startTime = 2
```

stopTime

```
public static final int stopTime
```

```
stopTime = 3
```

url

```
public static final int url
```

```
url = 4
```

V.5.108 org.iso.mpeg.mpegj.scene.EventOut.Appearance**V.5.108.1 Syntax**

```
public static interface EventOut.Appearance
```

V.5.108.2 Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>material</u> |

| | |
|-----|-------------------------|
| int | <u>texture</u> |
| int | <u>textureTransform</u> |

V.5.108.3Fields

material
 public static final int material
 material = 0

texture
 public static final int texture
 texture = 1

textureTransform
 public static final int textureTransform
 textureTransform = 2

V.5.109 org.iso.mpeg.mpegj.scene.EventOut.AudioBuffer**V.5.109.1Syntax**

```
public static interface EventOut.AudioBuffer
```

V.5.109.2Description

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>pitch</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>children</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |
| int | <u>duration_changed</u> |
| int | <u>isActive</u> |

V.5.109.3Fields

children
 public static final int children
 children = 4

duration_changed
 public static final int duration_changed
 duration_changed = 7

isActive
 public static final int isActive
 isActive = 8

loop
 public static final int loop
 loop = 0

numChan
 public static final int numChan
 numChan = 5

phaseGroup
 public static final int phaseGroup
 phaseGroup = 6

pitch
 public static final int pitch

```

pitch = 1
startTime
public static final int startTime
startTime = 2
stopTime
public static final int stopTime
stopTime = 3

```

V.5.110 org.iso.mpeg.mpegj.scene.EventOut.AudioClip

V.5.110.1 Syntax

```
public static interface EventOut.AudioClip
```

V.5.110.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>description</u> |
| int | <u>loop</u> |
| int | <u>pitch</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |
| int | <u>duration_changed</u> |
| int | <u>isActive</u> |

V.5.110.3 Fields

```

description
public static final int description
description = 0
duration_changed
public static final int duration_changed
duration_changed = 6
isActive
public static final int isActive
isActive = 7
loop
public static final int loop
loop = 1
pitch
public static final int pitch
pitch = 2
startTime
public static final int startTime
startTime = 3
stopTime
public static final int stopTime
stopTime = 4
url
public static final int url
url = 5

```

V.5.111 org.iso.mpeg.mpegj.scene.EventOut.AudioDelay**V.5.111.1 Syntax**

```
public static interface EventOut.AudioDelay
```

V.5.111.2 Description

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>children</u> |
| int | <u>delay</u> |

V.5.111.3 Fields**children**

```
public static final int children
```

```
children = 0
```

delay

```
public static final int delay
```

```
delay = 1
```

V.5.112 org.iso.mpeg.mpegj.scene.EventOut.AudioFX**V.5.112.1 Syntax**

```
public static interface EventOut.AudioFX
```

V.5.112.2 Description

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>children</u> |
| int | <u>orch</u> |
| int | <u>score</u> |
| int | <u>params</u> |

V.5.112.3 Fields**children**

```
public static final int children
```

```
children = 0
```

orch

```
public static final int orch
```

```
orch = 1
```

params

```
public static final int params
```

```
params = 3
```

score

```
public static final int score
```

```
score = 2
```

V.5.113 org.iso.mpeg.mpegj.scene.EventOut.AudioMix**V.5.113.1 Syntax**

```
public static interface EventOut.AudioMix
```

V.5.113.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>numInputs</u> |
| int | <u>matrix</u> |

V.5.113.3Fields

children

```
public static final int children
children = 0
```

matrix

```
public static final int matrix
matrix = 2
```

numInputs

```
public static final int numInputs
numInputs = 1
```

V.5.114 org.iso.mpeg.mpegj.scene.EventOut

V.5.114.1Syntax

```
public static interface EventOut
```

V.5.114.2Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>url</u> |
| int | <u>pitch</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |

V.5.114.3Fields

children

```
public static final int children
children = 0
```

pitch

```
public static final int pitch
pitch = 2
```

speed

```
public static final int speed
speed = 3
```

startTime

```
public static final int startTime
startTime = 4
```

stopTime

```
public static final int stopTime
stopTime = 5
```

url

```
public static final int url
url = 1
```

V.5.115 org.iso.mpeg.mpegj.scene.EventOut.AudioSwitch**V.5.115.1 Syntax**

```
public static interface EventOut.AudioSwitch
```

V.5.115.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>whichChoice</u> |

V.5.115.3 Fields**children**

```
public static final int children
```

```
children = 0
```

whichChoice

```
public static final int whichChoice
```

```
whichChoice = 1
```

V.5.116 org.iso.mpeg.mpegj.scene.EventOut.Background**V.5.116.1 Syntax**

```
public static interface EventOut.Background
```

V.5.116.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>groundAngle</u> |
| int | <u>groundColor</u> |
| int | <u>backUrl</u> |
| int | <u>bottomUrl</u> |
| int | <u>frontUrl</u> |
| int | <u>leftUrl</u> |
| int | <u>rightUrl</u> |
| int | <u>topUrl</u> |
| int | <u>skyAngle</u> |
| int | <u>skyColor</u> |
| int | <u>isBound</u> |

V.5.116.3 Fields**backUrl**

```
public static final int backUrl
```

```
backUrl = 2
```

bottomUrl

```
public static final int bottomUrl
```

```
bottomUrl = 3
```

frontUrl

```
public static final int frontUrl
```

```
frontUrl = 4
```

groundAngle

```
public static final int groundAngle
```

```
groundAngle = 0
```

groundColor

```
public static final int groundColor
```

```

groundColor = 1
isBound
public static final int isBound
isBound = 10
leftUrl
public static final int leftUrl
leftUrl = 5
rightUrl
public static final int rightUrl
rightUrl = 6
skyAngle
public static final int skyAngle
skyAngle = 8
skyColor
public static final int skyColor
skyColor = 9
topUrl
public static final int topUrl
topUrl = 7

```

V.5.117 org.iso.mpeg.mpegj.scene.EventOut.Background2D

V.5.117.1 Syntax

```
public static interface EventOut.Background2D
```

V.5.117.2 Description

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>backColor</u> |
| int | <u>url</u> |
| int | <u>isBound</u> |

V.5.117.3 Fields

```

backColor
public static final int backColor
backColor = 0
isBound
public static final int isBound
isBound = 2
url
public static final int url
url = 1

```

V.5.118 org.iso.mpeg.mpegj.scene.EventOut.Billboard

V.5.118.1 Syntax

```
public static interface EventOut.Billboard
```

V.5.118.2 Description

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>children</u> |

| | |
|-----|-----------------------|
| int | <u>axisOfRotation</u> |
|-----|-----------------------|

V.5.118.3Fields**axisOfRotation**

```
public static final int axisOfRotation
```

```
axisOfRotation = 1
```

children

```
public static final int children
```

```
children = 0
```

V.5.119 org.iso.mpeg.mpegj.scene.EventOut.Bitmap**V.5.119.1Syntax**

```
public static interface EventOut.Bitmap
```

V.5.119.2Description

| Member Summary | |
|----------------|------------------|
| Fields | int <u>scale</u> |

V.5.119.3Fields**scale**

```
public static final int scale
```

```
scale = 0
```

V.5.120 org.iso.mpeg.mpegj.scene.EventOut.Box**V.5.120.1Syntax**

```
public static interface EventOut.Box
```

V.5.120.2Description**V.5.121 org.iso.mpeg.mpegj.scene.EventOut.Circle****V.5.121.1Syntax**

```
public static interface EventOut.Circle
```

V.5.121.2Description

| Member Summary | |
|----------------|-------------------|
| Fields | int <u>radius</u> |

V.5.121.3Fields**radius**

```
public static final int radius
```

```
radius = 0
```

V.5.122 org.iso.mpeg.mpegj.scene.EventOut.Collision**V.5.122.1Syntax**

```
public static interface EventOut.Collision
```

V.5.122.2Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>collide</u> |
| int | <u>collideTime</u> |

V.5.122.3Fields

children

public static final int children

children = 0

collide

public static final int collide

collide = 1

collideTime

public static final int collideTime

collideTime = 2

V.5.123 org.iso.mpeg.mpegj.scene.EventOut.Color

V.5.123.1Syntax

public static interface EventOut.Color

V.5.123.2Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>color</u> |

V.5.123.3Fields

color

public static final int color

color = 0

V.5.124 org.iso.mpeg.mpegj.scene.EventOut.ColorInterpolator

V.5.124.1Syntax

public static interface EventOut.ColorInterpolator

V.5.124.2Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.124.3Fields

key

public static final int key

key = 0

keyValue

public static final int keyValue

```
keyValue = 1
value_changed
public static final int value_changed
value_changed = 2
```

V.5.125 org.iso.mpeg.mpegj.scene.EventOut.CompositeTexture2D**V.5.125.1 Syntax**

```
public static interface EventOut.CompositeTexture2D
```

V.5.125.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>pixelWidth</u> |
| int | <u>pixelHeight</u> |
| int | <u>background</u> |
| int | <u>viewport</u> |

V.5.125.3 Fields

background
 public static final int background
 background = 3

children
 public static final int children
 children = 0

pixelHeight
 public static final int pixelHeight
 pixelHeight = 2

pixelWidth
 public static final int pixelWidth
 pixelWidth = 1

viewport
 public static final int viewport
 viewport = 4

V.5.126 org.iso.mpeg.mpegj.scene.EventOut.CompositeTexture3D**V.5.126.1 Syntax**

```
public static interface EventOut.CompositeTexture3D
```

V.5.126.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>pixelWidth</u> |
| int | <u>pixelHeight</u> |
| int | <u>background</u> |
| int | <u>fog</u> |
| int | <u>navigationInfo</u> |
| int | <u>viewpoint</u> |

V.5.126.3 Fields

background

```

public static final int background
background = 3
children
public static final int children
children = 0
fog
public static final int fog
fog = 4
navigationInfo
public static final int navigationInfo
navigationInfo = 5
pixelHeight
public static final int pixelHeight
pixelHeight = 2
pixelWidth
public static final int pixelWidth
pixelWidth = 1
viewpoint
public static final int viewpoint
viewpoint = 6

```

V.5.127 org.iso.mpeg.mpegj.scene.EventOut.Conditional**V.5.127.1 Syntax**

```
public static interface EventOut.Conditional
```

V.5.127.2 Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>buffer</u> |
| int | <u>isActive</u> |

V.5.127.3 Fields

```

buffer
public static final int buffer
buffer = 0
isActive
public static final int isActive
isActive = 1

```

V.5.128 org.iso.mpeg.mpegj.scene.EventOut.Cone**V.5.128.1 Syntax**

```
public static interface EventOut.Cone
```

V.5.128.2 Description**V.5.129 org.iso.mpeg.mpegj.scene.EventOut.Coordinate****V.5.129.1 Syntax**

```
public static interface EventOut.Coordinate
```

V.5.129.2Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.129.3Fields

point
 public static final int point
 point = 0

V.5.130 org.iso.mpeg.mpegj.scene.EventOut.Coordinate2D**V.5.130.1Syntax**

```
public static interface EventOut.Coordinate2D
```

V.5.130.2Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.130.3Fields

point
 public static final int point
 point = 0

V.5.131 org.iso.mpeg.mpegj.scene.EventOut.CoordinateInterpolator**V.5.131.1Syntax**

```
public static interface EventOut.CoordinateInterpolator
```

V.5.131.2Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.131.3Fields

key
 public static final int key
 key = 0

keyValue
 public static final int keyValue
 keyValue = 1

value_changed
 public static final int value_changed
 value_changed = 2

V.5.132 org.iso.mpeg.mpegj.scene.EventOut.CoordinateInterpolator2D**V.5.132.1 Syntax**

```
public static interface EventOut.CoordinateInterpolator2D
```

V.5.132.2 Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.132.3 Fields

key
public static final int key

key = 0

keyValue
public static final int keyValue

keyValue = 1

value_changed
public static final int value_changed

value_changed = 2

V.5.133 org.iso.mpeg.mpegj.scene.EventOut.Curve2D**V.5.133.1 Syntax**

```
public static interface EventOut.Curve2D
```

V.5.133.2 Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>point</u> |
| int | <u>fineness</u> |
| int | <u>type</u> |

V.5.133.3 Fields

fineness
public static final int fineness

fineness = 1

point
public static final int point

point = 0

type
public static final int type

type = 2

V.5.134 org.iso.mpeg.mpegj.scene.EventOut.Cylinder**V.5.134.1 Syntax**

```
public static interface EventOut.Cylinder
```

V.5.134.2 Description**V.5.135 org.iso.mpeg.mpegj.scene.EventOut.CylinderSensor****V.5.135.1 Syntax**

```
public static interface EventOut.CylinderSensor
```

V.5.135.2 Description

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>diskAngle</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |
| int | <u>isActive</u> |
| int | <u>rotation_changed</u> |
| int | <u>trackPoint_changed</u> |

V.5.135.3 Fields

autoOffset
 public static final int autoOffset
 autoOffset = 0

diskAngle
 public static final int diskAngle
 diskAngle = 1

enabled
 public static final int enabled
 enabled = 2

isActive
 public static final int isActive
 isActive = 6

maxAngle
 public static final int maxAngle
 maxAngle = 3

minAngle
 public static final int minAngle
 minAngle = 4

offset
 public static final int offset
 offset = 5

rotation_changed
 public static final int rotation_changed
 rotation_changed = 7

trackPoint_changed
 public static final int trackPoint_changed
 trackPoint_changed = 8

V.5.136 org.iso.mpeg.mpegj.scene.EventOut.DirectionalLight**V.5.136.1 Syntax**

```
public static interface EventOut.DirectionalLight
```

V.5.136.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>color</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>on</u> |

V.5.136.3Fields

ambientIntensity

public static final int ambientIntensity

ambientIntensity = 0

color

public static final int color

color = 1

direction

public static final int direction

direction = 2

intensity

public static final int intensity

intensity = 3

on

public static final int on

on = 4

V.5.137 org.iso.mpeg.mpegj.scene.EventOut.DiscSensor

V.5.137.1Syntax

```
public static interface EventOut.DiscSensor
```

V.5.137.2Description

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |
| int | <u>isActive</u> |
| int | <u>rotation_changed</u> |
| int | <u>trackPoint_changed</u> |

V.5.137.3Fields

autoOffset

public static final int autoOffset

autoOffset = 0

enabled

public static final int enabled

enabled = 1

isActive

public static final int isActive

isActive = 5

```

maxAngle
public static final int maxAngle
maxAngle = 2

minAngle
public static final int minAngle
minAngle = 3

offset
public static final int offset
offset = 4

rotation_changed
public static final int rotation_changed
rotation_changed = 6

trackPoint_changed
public static final int trackPoint_changed
trackPoint_changed = 7

```

V.5.138 org.iso.mpeg.mpegj.scene.EventOut.ElevationGrid**V.5.138.1 Syntax**

```
public static interface EventOut.ElevationGrid
```

V.5.138.2 Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>color</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |

V.5.138.3 Fields

```

color
public static final int color
color = 0

normal
public static final int normal
normal = 1

texCoord
public static final int texCoord
texCoord = 2

```

V.5.139 org.iso.mpeg.mpegj.scene.EventOut.Expression**V.5.139.1 Syntax**

```
public static interface EventOut.Expression
```

V.5.139.2 Description

| Member Summary | |
|-----------------------|------------------------------|
| Fields | |
| int | <u>expression_select1</u> |
| int | <u>expression_intensity1</u> |
| int | <u>expression_select2</u> |
| int | <u>expression_intensity2</u> |
| int | <u>init_face</u> |
| int | <u>expression_def</u> |

V.5.139.3Fields

```

expression_def
public static final int expression_def
expression_def = 5

expression_intensity1
public static final int expression_intensity1
expression_intensity1 = 1

expression_intensity2
public static final int expression_intensity2
expression_intensity2 = 3

expression_select1
public static final int expression_select1
expression_select1 = 0

expression_select2
public static final int expression_select2
expression_select2 = 2

init_face
public static final int init_face
init_face = 4

```

V.5.140 org.iso.mpeg.mpegj.scene.EventOut.Extrusion**V.5.140.1Syntax**

```
public static interface EventOut.Extrusion
```

V.5.140.2Description**V.5.141 org.iso.mpeg.mpegj.scene.EventOut.Face****V.5.141.1Syntax**

```
public static interface EventOut.Face
```

V.5.141.2Description

| Member Summary | |
|----------------|---------------------|
| Fields | |
| int | <u>fap</u> |
| int | <u>fdp</u> |
| int | <u>fit</u> |
| int | <u>ttsSource</u> |
| int | <u>renderedFace</u> |

V.5.141.3Fields

```

fap
public static final int fap
fap = 0

fdp
public static final int fdp
fdp = 1

fit
public static final int fit
fit = 2

renderedFace

```

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```
public static final int renderedFace  
renderedFace = 4  
ttsSource  
public static final int ttsSource  
ttsSource = 3
```

V.5.142 org.iso.mpeg.mpegj.scene.EventOut.FaceDefMesh

V.5.142.1 Syntax

```
public static interface EventOut.FaceDefMesh
```

V.5.142.2 Description

V.5.143 org.iso.mpeg.mpegj.scene.EventOut.FaceDefTables

V.5.143.1 Syntax

```
public static interface EventOut.FaceDefTables
```

V.5.143.2 Description

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>faceDefMesh</u> |
| int | <u>faceDefTransform</u> |

V.5.143.3 Fields

faceDefMesh

```
public static final int faceDefMesh  
faceDefMesh = 0
```

faceDefTransform

```
public static final int faceDefTransform  
faceDefTransform = 1
```

V.5.144 org.iso.mpeg.mpegj.scene.EventOut.FaceDefTransform

V.5.144.1 Syntax

```
public static interface EventOut.FaceDefTransform
```

V.5.144.2 Description

V.5.145 org.iso.mpeg.mpegj.scene.EventOut.FAP

V.5.145.1 Syntax

```
public static interface EventOut.FAP
```

V.5.145.2 Description

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>viseme</u> |
| int | <u>expression</u> |
| int | <u>open_jaw</u> |
| int | <u>lower_t_midlip</u> |
| int | <u>raise_b_midlip</u> |
| int | <u>stretch_l_corner</u> |
| int | <u>stretch_r_corner</u> |
| int | <u>lower_t_lip_lm</u> |

```

int    lower_t_lip_rm
int    lower_b_lip_lm
int    lower_b_lip_rm
int    raise_l_cornerlip
int    raise_r_cornerlip
int    thrust_jaw
int    shift_jaw
int    push_b_lip
int    push_t_lip
int    depress_chin
int    close_t_l_eyelid
int    close_t_r_eyelid
int    close_b_l_eyelid
int    close_b_r_eyelid
int    yaw_l_eyeball
int    yaw_r_eyeball
int    pitch_l_eyeball
int    pitch_r_eyeball
int    thrust_l_eyeball
int    thrust_r_eyeball
int    dilate_l_pupil
int    dilate_r_pupil
int    raise_l_i_eyebrow
int    raise_r_i_eyebrow
int    raise_l_m_eyebrow
int    raise_r_m_eyebrow
int    raise_l_o_eyebrow
int    raise_r_o_eyebrow
int    squeeze_l_eyebrow
int    squeeze_r_eyebrow
int    puff_l_cheek
int    puff_r_cheek
int    lift_l_cheek
int    lift_r_cheek
int    shift_tongue_tip
int    raise_tongue_tip
int    thrust_tongue_tip
int    raise_tongue
int    tongue_roll
int    head_pitch
int    head_yaw
int    head_roll
int    lower_t_midlip_o
int    raise_b_midlip_o
int    stretch_l_cornerlip
int    stretch_r_cornerlip
int    lower_t_lip_lm_o
int    lower_t_lip_rm_o
int    raise_b_lip_lm_o
int    raise_b_lip_rm_o
int    raise_l_cornerlip_o
int    raise_r_cornerlip_o
int    stretch_l_nose
int    stretch_r_nose
int    raise_nose
int    bend_nose
int    raise_l_ear
int    raise_r_ear
int    pull_l_ear
int    pull_r_ear

```

V.5.145.3Fields

bend_nose

```
public static final int bend_nose
```

```
bend_nose = 63
```

close_b_l_eyelid

```
public static final int close_b_l_eyelid
```

```
close_b_l_eyelid = 20
```

```

close_b_r_eyelid
public static final int close_b_r_eyelid
close_b_r_eyelid = 21

close_t_l_eyelid
public static final int close_t_l_eyelid
close_t_l_eyelid = 18

close_t_r_eyelid
public static final int close_t_r_eyelid
close_t_r_eyelid = 19

depress_chin
public static final int depress_chin
depress_chin = 17

dilate_l_pupil
public static final int dilate_l_pupil
dilate_l_pupil = 28

dilate_r_pupil
public static final int dilate_r_pupil
dilate_r_pupil = 29

expression
public static final int expression
expression = 1

head_pitch
public static final int head_pitch
head_pitch = 47

head_roll
public static final int head_roll
head_roll = 49

head_yaw
public static final int head_yaw
head_yaw = 48

lift_l_cheek
public static final int lift_l_cheek
lift_l_cheek = 40

lift_r_cheek
public static final int lift_r_cheek
lift_r_cheek = 41

lower_b_lip_lm
public static final int lower_b_lip_lm
lower_b_lip_lm = 9

lower_b_lip_rm
public static final int lower_b_lip_rm
lower_b_lip_rm = 10

lower_t_lip_lm
public static final int lower_t_lip_lm
lower_t_lip_lm = 7

lower_t_lip_lm_o
public static final int lower_t_lip_lm_o
lower_t_lip_lm_o = 54

lower_t_lip_rm
public static final int lower_t_lip_rm
lower_t_lip_rm = 8

```

```

lower_t_lip_rm_o
public static final int lower_t_lip_rm_o
lower_t_lip_rm_o = 55

lower_t_midlip
public static final int lower_t_midlip
lower_t_midlip = 3

lower_t_midlip_o
public static final int lower_t_midlip_o
lower_t_midlip_o = 50

open_jaw
public static final int open_jaw
open_jaw = 2

pitch_l_eyeball
public static final int pitch_l_eyeball
pitch_l_eyeball = 24

pitch_r_eyeball
public static final int pitch_r_eyeball
pitch_r_eyeball = 25

puff_l_cheek
public static final int puff_l_cheek
puff_l_cheek = 38

puff_r_cheek
public static final int puff_r_cheek
puff_r_cheek = 39

pull_l_ear
public static final int pull_l_ear
pull_l_ear = 66

pull_r_ear
public static final int pull_r_ear
pull_r_ear = 67

push_b_lip
public static final int push_b_lip
push_b_lip = 15

push_t_lip
public static final int push_t_lip
push_t_lip = 16

raise_b_lip_lm_o
public static final int raise_b_lip_lm_o
raise_b_lip_lm_o = 56

raise_b_lip_rm_o
public static final int raise_b_lip_rm_o
raise_b_lip_rm_o = 57

raise_b_midlip
public static final int raise_b_midlip
raise_b_midlip = 4

raise_b_midlip_o
public static final int raise_b_midlip_o
raise_b_midlip_o = 51

raise_l_cornerlip
public static final int raise_l_cornerlip
raise_l_cornerlip = 11

```

```
raise_l_cornerlip_o
public static final int raise_l_cornerlip_o
raise_l_cornerlip_o = 58
raise_l_ear
public static final int raise_l_ear
raise_l_ear = 64
raise_l_i_eyebrow
public static final int raise_l_i_eyebrow
raise_l_i_eyebrow = 30
raise_l_m_eyebrow
public static final int raise_l_m_eyebrow
raise_l_m_eyebrow = 32
raise_l_o_eyebrow
public static final int raise_l_o_eyebrow
raise_l_o_eyebrow = 34
raise_nose
public static final int raise_nose
raise_nose = 62
raise_r_cornerlip
public static final int raise_r_cornerlip
raise_r_cornerlip = 12
raise_r_cornerlip_o
public static final int raise_r_cornerlip_o
raise_r_cornerlip_o = 59
raise_r_ear
public static final int raise_r_ear
raise_r_ear = 65
raise_r_i_eyebrow
public static final int raise_r_i_eyebrow
raise_r_i_eyebrow = 31
raise_r_m_eyebrow
public static final int raise_r_m_eyebrow
raise_r_m_eyebrow = 33
raise_r_o_eyebrow
public static final int raise_r_o_eyebrow
raise_r_o_eyebrow = 35
raise_tongue
public static final int raise_tongue
raise_tongue = 45
raise_tongue_tip
public static final int raise_tongue_tip
raise_tongue_tip = 43
shift_jaw
public static final int shift_jaw
shift_jaw = 14
shift_tongue_tip
public static final int shift_tongue_tip
shift_tongue_tip = 42
squeeze_l_eyebrow
public static final int squeeze_l_eyebrow
squeeze_l_eyebrow = 36
```

```

squeeze_r_eyebrow
public static final int squeeze_r_eyebrow
squeeze_r_eyebrow = 37

stretch_l_corner
public static final int stretch_l_corner
stretch_l_corner = 5

stretch_l_cornerlip
public static final int stretch_l_cornerlip
stretch_l_cornerlip = 52

stretch_l_nose
public static final int stretch_l_nose
stretch_l_nose = 60

stretch_r_corner
public static final int stretch_r_corner
stretch_r_corner = 6

stretch_r_cornerlip
public static final int stretch_r_cornerlip
stretch_r_cornerlip = 53

stretch_r_nose
public static final int stretch_r_nose
stretch_r_nose = 61

thrust_jaw
public static final int thrust_jaw
thrust_jaw = 13

thrust_l_eyeball
public static final int thrust_l_eyeball
thrust_l_eyeball = 26

thrust_r_eyeball
public static final int thrust_r_eyeball
thrust_r_eyeball = 27

thrust_tongue_tip
public static final int thrust_tongue_tip
thrust_tongue_tip = 44

tongue_roll
public static final int tongue_roll
tongue_roll = 46

viseme
public static final int viseme
viseme = 0

yaw_l_eyeball
public static final int yaw_l_eyeball
yaw_l_eyeball = 22

yaw_r_eyeball
public static final int yaw_r_eyeball
yaw_r_eyeball = 23

```

V.5.146 org.iso.mpeg.mpegj.scene.EventOut.FDP

V.5.146.1 Syntax

```
public static interface EventOut.FDP
```

V.5.146.2Description

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>featurePointsCoord</u> |
| int | <u>textureCoord</u> |
| int | <u>faceDefTables</u> |
| int | <u>faceSceneGraph</u> |

V.5.146.3Fields**faceDefTables**

```
public static final int faceDefTables
```

faceDefTables = 2

faceSceneGraph

```
public static final int faceSceneGraph
```

faceSceneGraph = 3

featurePointsCoord

```
public static final int featurePointsCoord
```

featurePointsCoord = 0

textureCoord

```
public static final int textureCoord
```

textureCoord = 1

V.5.147 org.iso.mpeg.mpegj.scene.EventOut.FIT**V.5.147.1Syntax**

```
public static interface EventOut.FIT
```

V.5.147.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>FAPs</u> |
| int | <u>Graph</u> |
| int | <u>numeratorExp</u> |
| int | <u>denominatorExp</u> |
| int | <u>numeratorImpulse</u> |
| int | <u>numeratorTerms</u> |
| int | <u>denominatorTerms</u> |
| int | <u>numeratorCoefs</u> |
| int | <u>denominatorCoefs</u> |

V.5.147.3Fields**denominatorCoefs**

```
public static final int denominatorCoefs
```

denominatorCoefs = 8

denominatorExp

```
public static final int denominatorExp
```

denominatorExp = 3

denominatorTerms

```
public static final int denominatorTerms
```

denominatorTerms = 6

FAPs

```
public static final int FAPs
```

FAPs = 0

```

Graph
public static final int Graph
Graph = 1
numeratorCoefs
public static final int numeratorCoefs
numeratorCoefs = 7
numeratorExp
public static final int numeratorExp
numeratorExp = 2
numeratorImpulse
public static final int numeratorImpulse
numeratorImpulse = 4
numeratorTerms
public static final int numeratorTerms
numeratorTerms = 5

```

V.5.148 org.iso.mpeg.mpegj.scene.EventOut.Fog

V.5.148.1 Syntax

```
public static interface EventOut.Fog
```

V.5.148.2 Description

| Member Summary | |
|-----------------------|------------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>fogType</u> |
| int | <u>visibilityRange</u> |
| int | <u>isBound</u> |

V.5.148.3 Fields

```

color
public static final int color
color = 0

fogType
public static final int fogType
fogType = 1

isBound
public static final int isBound
isBound = 3

visibilityRange
public static final int visibilityRange
visibilityRange = 2

```

V.5.149 org.iso.mpeg.mpegj.scene.EventOut.FontStyle

V.5.149.1 Syntax

```
public static interface EventOut.FontStyle
```

V.5.149.2Description**V.5.150 org.iso.mpeg.mpegj.scene.EventOut.Form****V.5.150.1Syntax**

```
public static interface EventOut.Form
```

V.5.150.2Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>size</u> |
| int | <u>groups</u> |
| int | <u>constraints</u> |
| int | <u>groupsIndex</u> |

V.5.150.3Fields**children**

```
public static final int children
```

children = 0

constraints

```
public static final int constraints
```

constraints = 3

groups

```
public static final int groups
```

groups = 2

groupsIndex

```
public static final int groupsIndex
```

groupsIndex = 4

size

```
public static final int size
```

size = 1

V.5.151 org.iso.mpeg.mpegj.scene.EventOut.Group**V.5.151.1Syntax**

```
public static interface EventOut.Group
```

V.5.151.2Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>children</u> |

V.5.151.3Fields**children**

```
public static final int children
```

children = 0

V.5.152 org.iso.mpeg.mpegj.scene.EventOut.ImageTexture**V.5.152.1Syntax**

```
public static interface EventOut.ImageTexture
```

V.5.152.2Description

| Member Summary | |
|-----------------------|------------|
| Fields | |
| int | <u>url</u> |

V.5.152.3Fields

url
 public static final int url
 url = 0

V.5.153 org.iso.mpeg.mpegj.scene.EventOut.IndexedFaceSet

V.5.153.1 Syntax

public static interface EventOut.IndexedFaceSet

V.5.153.2Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |

V.5.153.3Fields

color
 public static final int color
 color = 0

coord
 public static final int coord
 coord = 1

normal
 public static final int normal
 normal = 2

texCoord
 public static final int texCoord
 texCoord = 3

V.5.154 org.iso.mpeg.mpegj.scene.EventOut.IndexedFaceSet2D

V.5.154.1 Syntax

public static interface EventOut.IndexedFaceSet2D

V.5.154.2Description

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>texCoord</u> |

V.5.154.3Fields

color
 public static final int color

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```
color = 0
coord
public static final int coord
coord = 1
texCoord
public static final int texCoord
texCoord = 2
```

V.5.155 org.iso.mpeg.mpegj.scene.EventOut.IndexedLineSet

V.5.155.1 Syntax

```
public static interface EventOut.IndexedLineSet
```

V.5.155.2 Description

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.155.3 Fields

```
color
public static final int color
color = 0
coord
public static final int coord
coord = 1
```

V.5.156 org.iso.mpeg.mpegj.scene.EventOut.IndexedLineSet2D

V.5.156.1 Syntax

```
public static interface EventOut.IndexedLineSet2D
```

V.5.156.2 Description

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.156.3 Fields

```
color
public static final int color
color = 0
coord
public static final int coord
coord = 1
```

V.5.157 org.iso.mpeg.mpegj.scene.EventOut.Inline

V.5.157.1 Syntax

```
public static interface EventOut.Inline
```

V.5.157.2 Description

| Member Summary | |
|-----------------------|------------|
| Fields | |
| int | <u>url</u> |

V.5.157.3 Fields

url
 public static final int url
 url = 0

V.5.158 org.iso.mpeg.mpegj.scene.EventOut.Layer2D

V.5.158.1 Syntax

```
public static interface EventOut.Layer2D
```

V.5.158.2 Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>size</u> |
| int | <u>background</u> |
| int | <u>viewport</u> |

V.5.158.3 Fields

background
 public static final int background
 background = 2

children
 public static final int children
 children = 0

size
 public static final int size
 size = 1

viewport
 public static final int viewport
 viewport = 3

V.5.159 org.iso.mpeg.mpegj.scene.EventOut.Layer3D

V.5.159.1 Syntax

```
public static interface EventOut.Layer3D
```

V.5.159.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>size</u> |
| int | <u>background</u> |
| int | <u>fog</u> |
| int | <u>navigationInfo</u> |
| int | <u>viewpoint</u> |

V.5.159.3 Fields

background

```
public static final int background
background = 2
children
public static final int children
children = 0
fog
public static final int fog
fog = 3
navigationInfo
public static final int navigationInfo
navigationInfo = 4
size
public static final int size
size = 1
viewpoint
public static final int viewpoint
viewpoint = 5
```

V.5.160 org.iso.mpeg.mpegj.scene.EventOut.Layout

V.5.160.1 Syntax

```
public static interface EventOut.Layout
```

V.5.160.2 Description

| Member Summary | |
|----------------|-----------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>wrap</u> |
| int | <u>size</u> |
| int | <u>horizontal</u> |
| int | <u>justify</u> |
| int | <u>leftToRight</u> |
| int | <u>topToBottom</u> |
| int | <u>spacing</u> |
| int | <u>smoothScroll</u> |
| int | <u>loop</u> |
| int | <u>scrollVertical</u> |
| int | <u>scrollRate</u> |

V.5.160.3 Fields

```
children
public static final int children
children = 0
horizontal
public static final int horizontal
horizontal = 3
justify
public static final int justify
justify = 4
leftToRight
public static final int leftToRight
leftToRight = 5
loop
public static final int loop
```

```

loop = 9
scrollRate
public static final int scrollRate
scrollRate = 11
scrollVertical
public static final int scrollVertical
scrollVertical = 10
size
public static final int size
size = 2
smoothScroll
public static final int smoothScroll
smoothScroll = 8
spacing
public static final int spacing
spacing = 7
topToBottom
public static final int topToBottom
topToBottom = 6
wrap
public static final int wrap
wrap = 1

```

V.5.161 org.iso.mpeg.mpegj.scene.EventOut.LineProperties

V.5.161.1 Syntax

```
public static interface EventOut.LineProperties
```

V.5.161.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>lineColor</u> |
| int | <u>lineStyle</u> |
| int | <u>width</u> |

V.5.161.3 Fields

```

lineColor
public static final int lineColor
lineColor = 0
lineStyle
public static final int linestyle
linestyle = 1
width
public static final int width
width = 2

```

V.5.162 org.iso.mpeg.mpegj.scene.EventOut.ListeningPoint

V.5.162.1 Syntax

```
public static interface EventOut.ListeningPoint
```

V.5.162.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>jump</u> |
| int | <u>orientation</u> |
| int | <u>position</u> |
| int | <u>bindTime</u> |
| int | <u>isBound</u> |

V.5.162.3 Fields

bindTime

public static final int bindTime

bindTime = 3

isBound

public static final int isBound

isBound = 4

jump

public static final int jump

jump = 0

orientation

public static final int orientation

orientation = 1

position

public static final int position

position = 2

V.5.163 org.iso.mpeg.mpegj.scene.EventOut.LOD

V.5.163.1 Syntax

public static interface EventOut.LOD

V.5.163.2 Description

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>level</u> |

V.5.163.3 Fields

level

public static final int level

level = 0

V.5.164 org.iso.mpeg.mpegj.scene.EventOut.Material

V.5.164.1 Syntax

public static interface EventOut.Material

V.5.164.2 Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>diffuseColor</u> |
| int | <u>emissiveColor</u> |
| int | <u>shininess</u> |
| int | <u>specularColor</u> |
| int | <u>transparency</u> |

V.5.164.3 Fields

```

ambientIntensity
public static final int ambientIntensity
ambientIntensity = 0

diffuseColor
public static final int diffuseColor
diffuseColor = 1

emissiveColor
public static final int emissiveColor
emissiveColor = 2

shininess
public static final int shininess
shininess = 3

specularColor
public static final int specularColor
specularColor = 4

transparency
public static final int transparency
transparency = 5

```

V.5.165 org.iso.mpeg.mpegj.scene.EventOut.Material2D

V.5.165.1 Syntax

```
public static interface EventOut.Material2D
```

V.5.165.2 Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>emissiveColor</u> |
| int | <u>filled</u> |
| int | <u>lineProps</u> |
| int | <u>transparency</u> |

V.5.165.3 Fields

```

emissiveColor
public static final int emissiveColor
emissiveColor = 0

filled
public static final int filled
filled = 1

lineProps
public static final int lineProps
lineProps = 2

transparency
public static final int transparency
transparency = 3

```

V.5.166 org.iso.mpeg.mpegj.scene.EventOut.MovieTexture

V.5.166.1 Syntax

```
public static interface EventOut.MovieTexture
```

V.5.166.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |
| int | <u>duration_changed</u> |
| int | <u>isActive</u> |

V.5.166.3Fields**duration_changed**

public static final int duration_changed

duration_changed = 5

isActive

public static final int isActive

isActive = 6

loop

public static final int loop

loop = 0

speed

public static final int speed

speed = 1

startTime

public static final int startTime

startTime = 2

stopTime

public static final int stopTime

stopTime = 3

url

public static final int url

url = 4

V.5.167 org.iso.mpeg.mpegj.scene.EventOut.NavigationInfo**V.5.167.1Syntax**

public static interface EventOut.NavigationInfo

V.5.167.2Description

| Member Summary | |
|-----------------------|------------------------|
| Fields | |
| int | <u>avatarSize</u> |
| int | <u>headlight</u> |
| int | <u>speed</u> |
| int | <u>type</u> |
| int | <u>visibilityLimit</u> |
| int | <u>isBound</u> |

V.5.167.3Fields**avatarSize**

public static final int avatarSize

avatarSize = 0

```

headlight
public static final int headlight
headlight = 1

isBound
public static final int isBound
isBound = 5

speed
public static final int speed
speed = 2

type
public static final int type
type = 3

visibilityLimit
public static final int visibilityLimit
visibilityLimit = 4

```

V.5.168 org.iso.mpeg.mpegj.scene.EventOut.Normal

V.5.168.1 Syntax

```
public static interface EventOut.Normal
```

V.5.168.2 Description

| Member Summary | |
|-----------------------|---------------|
| Fields | |
| int | <u>vector</u> |

V.5.168.3 Fields

```

vector
public static final int vector
vector = 0

```

V.5.169 org.iso.mpeg.mpegj.scene.EventOut.NormalInterpolator

V.5.169.1 Syntax

```
public static interface EventOut.NormalInterpolator
```

V.5.169.2 Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.169.3 Fields

```

key
public static final int key
key = 0

keyValue
public static final int keyValue
keyValue = 1

value_changed
public static final int value_changed

```

value_changed = 2

V.5.170 org.iso.mpeg.mpegj.scene.EventOut.OrderedGroup

V.5.170.1 Syntax

```
public static interface EventOut.OrderedGroup
```

V.5.170.2 Description

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>children</u> |
| int | <u>order</u> |

V.5.170.3 Fields

children

public static final int children

children = 0

order

public static final int order

order = 1

V.5.171 org.iso.mpeg.mpegj.scene.EventOut.OrientationInterpolator

V.5.171.1 Syntax

```
public static interface EventOut.OrientationInterpolator
```

V.5.171.2 Description

| Member Summary | |
|----------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.171.3 Fields

key

public static final int key

key = 0

keyValue

public static final int keyValue

keyValue = 1

value_changed

public static final int value_changed

value_changed = 2

V.5.172 org.iso.mpeg.mpegj.scene.EventOut.PixelTexture

V.5.172.1 Syntax

```
public static interface EventOut.PixelTexture
```

V.5.172.2 Description

| Member Summary | |
|----------------|--|
| Fields | |

| | |
|-----|--------------|
| int | <u>image</u> |
|-----|--------------|

V.5.172.3Fields

image
 public static final int image
 image = 0

V.5.173 org.iso.mpeg.mpegj.scene.EventOut.PlaneSensor**V.5.173.1Syntax**

public static interface EventOut.PlaneSensor

V.5.173.2Description

| Member Summary | |
|----------------|----------------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |
| int | <u>isActive</u> |
| int | <u>trackPoint_changed</u> |
| int | <u>translation_changed</u> |

V.5.173.3Fields

autoOffset
 public static final int autoOffset
 autoOffset = 0

enabled
 public static final int enabled
 enabled = 1

isActive
 public static final int isActive
 isActive = 5

maxPosition
 public static final int maxPosition
 maxPosition = 2

minPosition
 public static final int minPosition
 minPosition = 3

offset
 public static final int offset
 offset = 4

trackPoint_changed
 public static final int trackPoint_changed
 trackPoint_changed = 6

translation_changed
 public static final int translation_changed
 translation_changed = 7

V.5.174 org.iso.mpeg.mpegj.scene.EventOut.PlaneSensor2D**V.5.174.1Syntax**

public static interface EventOut.PlaneSensor2D

V.5.174.2Description

| Member Summary | |
|-----------------------|----------------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |
| int | <u>isActive</u> |
| int | <u>trackPoint_changed</u> |
| int | <u>translation_changed</u> |

V.5.174.3Fields

autoOffset
 public static final int autoOffset
 autoOffset = 0

enabled
 public static final int enabled
 enabled = 1

isActive
 public static final int isActive
 isActive = 5

maxPosition
 public static final int maxPosition
 maxPosition = 2

minPosition
 public static final int minPosition
 minPosition = 3

offset
 public static final int offset
 offset = 4

trackPoint_changed
 public static final int trackPoint_changed
 trackPoint_changed = 6

translation_changed
 public static final int translation_changed
 translation_changed = 7

V.5.175 org.iso.mpeg.mpegj.scene.EventOut.PointLight**V.5.175.1Syntax**

```
public static interface EventOut.PointLight
```

V.5.175.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>color</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.175.3Fields**ambientIntensity**

```
public static final int ambientIntensity
```

```
ambientIntensity = 0
```

attenuation

```
public static final int attenuation
```

```
attenuation = 1
```

color

```
public static final int color
```

```
color = 2
```

intensity

```
public static final int intensity
```

```
intensity = 3
```

location

```
public static final int location
```

```
location = 4
```

on

```
public static final int on
```

```
on = 5
```

radius

```
public static final int radius
```

```
radius = 6
```

V.5.176 org.iso.mpeg.mpegj.scene.EventOut.PointSet**V.5.176.1Syntax**

```
public static interface EventOut.PointSet
```

V.5.176.2Description

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.176.3Fields**color**

```
public static final int color
```

```
color = 0
```

coord

```
public static final int coord
```

```
coord = 1
```

V.5.177 org.iso.mpeg.mpegj.scene.EventOut.PointSet2D**V.5.177.1Syntax**

```
public static interface EventOut.PointSet2D
```

V.5.177.2Description

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.177.3Fields

```
color
public static final int color
color = 0

coord
public static final int coord
coord = 1
```

V.5.178 org.iso.mpeg.mpegj.scene.EventOut.PositionInterpolator**V.5.178.1Syntax**

```
public static interface EventOut.PositionInterpolator
```

V.5.178.2Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.178.3Fields

```
key
public static final int key
key = 0

keyValue
public static final int keyValue
keyValue = 1

value_changed
public static final int value_changed
value_changed = 2
```

V.5.179 org.iso.mpeg.mpegj.scene.EventOut.PositionInterpolator2D**V.5.179.1Syntax**

```
public static interface EventOut.PositionInterpolator2D
```

V.5.179.2Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.179.3Fields

```
key
public static final int key
key = 0

keyValue
public static final int keyValue
keyValue = 1
```

```
value_changed
public static final int value_changed
value_changed = 2
```

V.5.180 org.iso.mpeg.mpegj.scene.EventOut.ProximitySensor

V.5.180.1 Syntax

```
public static interface EventOut.ProximitySensor
```

V.5.180.2 Description

| Member Summary | |
|-----------------------|----------------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |
| int | <u>isActive</u> |
| int | <u>position_changed</u> |
| int | <u>orientation_changed</u> |
| int | <u>enterTime</u> |
| int | <u>exitTime</u> |

V.5.180.3 Fields

center

```
public static final int center
center = 0
```

enabled

```
public static final int enabled
enabled = 2
```

enterTime

```
public static final int enterTime
enterTime = 6
```

exitTime

```
public static final int exitTime
exitTime = 7
```

isActive

```
public static final int isActive
isActive = 3
```

orientation_changed

```
public static final int orientation_changed
orientation_changed = 5
```

position_changed

```
public static final int position_changed
position_changed = 4
```

size

```
public static final int size
size = 1
```

V.5.181 org.iso.mpeg.mpegj.scene.EventOut.ProximitySensor2D

V.5.181.1 Syntax

```
public static interface EventOut.ProximitySensor2D
```

V.5.181.2 Description

| Member Summary | |
|-----------------------|----------------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |
| int | <u>isActive</u> |
| int | <u>position_changed</u> |
| int | <u>orientation_changed</u> |
| int | <u>enterTime</u> |
| int | <u>exitTime</u> |

V.5.181.3 Fields

center
 public static final int center
 center = 0

enabled
 public static final int enabled
 enabled = 2

enterTime
 public static final int enterTime
 enterTime = 6

exitTime
 public static final int exitTime
 exitTime = 7

isActive
 public static final int isActive
 isActive = 3

orientation_changed
 public static final int orientation_changed
 orientation_changed = 5

position_changed
 public static final int position_changed
 position_changed = 4

size
 public static final int size
 size = 1

V.5.182 org.iso.mpeg.mpegj.scene.EventOut.QuantizationParameter

V.5.182.1 Syntax

```
public static interface EventOut.QuantizationParameter
```

V.5.182.2 Description

V.5.183 org.iso.mpeg.mpegj.scene.EventOut.Rectangle

V.5.183.1 Syntax

```
public static interface EventOut.Rectangle
```

V.5.183.2 Description

| Member Summary | |
|-----------------------|-------------|
| Fields | |
| int | <u>size</u> |

V.5.183.3Fields

size
 public static final int size
 size = 0

V.5.184 org.iso.mpeg.mpegj.scene.EventOut.ScalarInterpolator**V.5.184.1Syntax**

```
public static interface EventOut.ScalarInterpolator
```

V.5.184.2Description

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |
| int | <u>value_changed</u> |

V.5.184.3Fields

key
 public static final int key
 key = 0

keyValue
 public static final int keyValue
 keyValue = 1

value_changed
 public static final int value_changed
 value_changed = 2

V.5.185 org.iso.mpeg.mpegj.scene.EventOut.Script**V.5.185.1Syntax**

```
public static interface EventOut.Script
```

V.5.185.2Description

| Member Summary | |
|-----------------------|------------|
| Fields | |
| int | <u>url</u> |

V.5.185.3Fields

url
 public static final int url
 url = 0

V.5.186 org.iso.mpeg.mpegj.scene.EventOut.Shape**V.5.186.1Syntax**

```
public static interface EventOut.Shape
```

V.5.186.2Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>appearance</u> |

| | |
|-----|-----------------|
| int | <u>geometry</u> |
|-----|-----------------|

V.5.186.3Fields**appearance**

public static final int appearance

appearance = 0

geometry

public static final int geometry

geometry = 1

V.5.187 org.iso.mpeg.mpegj.scene.EventOut.Sound**V.5.187.1Syntax**

public static interface EventOut.Sound

V.5.187.2Description

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>maxBack</u> |
| int | <u>maxFront</u> |
| int | <u>minBack</u> |
| int | <u>minFront</u> |
| int | <u>priority</u> |
| int | <u>source</u> |

V.5.187.3Fields**direction**

public static final int direction

direction = 0

intensity

public static final int intensity

intensity = 1

location

public static final int location

location = 2

maxBack

public static final int maxBack

maxBack = 3

maxFront

public static final int maxFront

maxFront = 4

minBack

public static final int minBack

minBack = 5

minFront

public static final int minFront

minFront = 6

priority

public static final int priority

priority = 7

source
 public static final int source
 source = 8

V.5.188 org.iso.mpeg.mpegj.scene.EventOut.Sound2D

V.5.188.1 Syntax

public static interface EventOut.Sound2D

V.5.188.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>source</u> |

V.5.188.3 Fields

intensity

public static final int intensity
 intensity = 0

location

public static final int location
 location = 1

source

public static final int source
 source = 2

V.5.189 org.iso.mpeg.mpegj.scene.EventOut.Sphere

V.5.189.1 Syntax

public static interface EventOut.Sphere

V.5.189.2 Description

V.5.190 org.iso.mpeg.mpegj.scene.EventOut.SphereSensor

V.5.190.1 Syntax

public static interface EventOut.SphereSensor

V.5.190.2 Description

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>offset</u> |
| int | <u>isActive</u> |
| int | <u>rotation changed</u> |
| int | <u>trackPoint changed</u> |

V.5.190.3 Fields

autoOffset

public static final int autoOffset
 autoOffset = 0

enabled

```
public static final int enabled
enabled = 1
isActive
public static final int isActive
isActive = 3
offset
public static final int offset
offset = 2
rotation_changed
public static final int rotation_changed
rotation_changed = 4
trackPoint_changed
public static final int trackPoint_changed
trackPoint_changed = 5
```

V.5.191 org.iso.mpeg.mpegj.scene.EventOut.SpotLight

V.5.191.1 Syntax

```
public static interface EventOut.SpotLight
```

V.5.191.2 Description

| Member Summary | |
|----------------|---|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>beamWidth</u> |
| int | <u>color</u> |
| int | <u>cutOffAngle</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.191.3 Fields

ambientIntensity

```
public static final int ambientIntensity
ambientIntensity = 0
```

attenuation

```
public static final int attenuation
attenuation = 1
```

beamWidth

```
public static final int beamWidth
beamWidth = 2
```

color

```
public static final int color
color = 3
```

cutOffAngle

```
public static final int cutOffAngle
cutOffAngle = 4
```

direction

```
public static final int direction
direction = 5
```

```

intensity
public static final int intensity
intensity = 6

location
public static final int location
location = 7

on
public static final int on
on = 8

radius
public static final int radius
radius = 9

```

V.5.192 org.iso.mpeg.mpegj.scene.EventOut.Switch

V.5.192.1 Syntax

```
public static interface EventOut.Switch
```

V.5.192.2 Description

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>choice</u> |
| int | <u>whichChoice</u> |

V.5.192.3 Fields

```

choice
public static final int choice
choice = 0

whichChoice
public static final int whichChoice
whichChoice = 1

```

V.5.193 org.iso.mpeg.mpegj.scene.EventOut.TermCap

V.5.193.1 Syntax

```
public static interface EventOut.TermCap
```

V.5.193.2 Description

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>capability</u> |
| int | <u>value</u> |

V.5.193.3 Fields

```

capability
public static final int capability
capability = 0

value
public static final int value
value = 1

```

V.5.194 org.iso.mpeg.mpegj.scene.EventOut.Text**V.5.194.1 Syntax**

```
public static interface EventOut.Text
```

V.5.194.2 Description

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>string</u> |
| int | <u>length</u> |
| int | <u>fontStyle</u> |
| int | <u>maxExtent</u> |

V.5.194.3 Fields**fontStyle**

```
public static final int fontStyle
```

```
fontStyle = 2
```

length

```
public static final int length
```

```
length = 1
```

maxExtent

```
public static final int maxExtent
```

```
maxExtent = 3
```

string

```
public static final int string
```

```
string = 0
```

V.5.195 org.iso.mpeg.mpegj.scene.EventOut.TextureCoordinate**V.5.195.1 Syntax**

```
public static interface EventOut.TextureCoordinate
```

V.5.195.2 Description

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.195.3 Fields**point**

```
public static final int point
```

```
point = 0
```

V.5.196 org.iso.mpeg.mpegj.scene.EventOut.TextureTransform**V.5.196.1 Syntax**

```
public static interface EventOut.TextureTransform
```

V.5.196.2 Description

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>rotation</u> |
| int | <u>scale</u> |

| | |
|-----|--------------------|
| int | <u>translation</u> |
|-----|--------------------|

V.5.196.3Fields

center
 public static final int center
 center = 0

rotation
 public static final int rotation
 rotation = 1

scale
 public static final int scale
 scale = 2

translation
 public static final int translation
 translation = 3

V.5.197 org.iso.mpeg.mpegj.scene.EventOut.TimeSensor**V.5.197.1Syntax**

```
public static interface EventOut.TimeSensor
```

V.5.197.2Description

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>cycleInterval</u> |
| int | <u>enabled</u> |
| int | <u>loop</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>cycleTime</u> |
| int | <u>fraction_changed</u> |
| int | <u>isActive</u> |
| int | <u>time</u> |

V.5.197.3Fields

cycleInterval
 public static final int cycleInterval
 cycleInterval = 0

cycleTime
 public static final int cycleTime
 cycleTime = 5

enabled
 public static final int enabled
 enabled = 1

fraction_changed
 public static final int fraction_changed
 fraction_changed = 6

isActive
 public static final int isActive
 isActive = 7

loop
 public static final int loop
 loop = 2

```

startTime
public static final int startTime
startTime = 3

stopTime
public static final int stopTime
stopTime = 4

time
public static final int time
time = 8

```

V.5.198 org.iso.mpeg.mpegj.scene.EventOut.TouchSensor**V.5.198.1 Syntax**

```
public static interface EventOut.TouchSensor
```

V.5.198.2 Description

| Member Summary | |
|----------------|----------------------------|
| Fields | |
| int | <u>enabled</u> |
| int | <u>hitNormal_changed</u> |
| int | <u>hitPoint_changed</u> |
| int | <u>hitTexCoord_changed</u> |
| int | <u>isActive</u> |
| int | <u>isOver</u> |
| int | <u>touchTime</u> |

V.5.198.3 Fields

```

enabled
public static final int enabled
enabled = 0

hitNormal_changed
public static final int hitNormal_changed
hitNormal_changed = 1

hitPoint_changed
public static final int hitPoint_changed
hitPoint_changed = 2

hitTexCoord_changed
public static final int hitTexCoord_changed
hitTexCoord_changed = 3

isActive
public static final int isActive
isActive = 4

isOver
public static final int isOver
isOver = 5

touchTime
public static final int touchTime
touchTime = 6

```

V.5.199 org.iso.mpeg.mpegj.scene.EventOut.Transform**V.5.199.1 Syntax**

```
public static interface EventOut.Transform
```

V.5.199.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>children</u> |
| int | <u>rotation</u> |
| int | <u>scale</u> |
| int | <u>scaleOrientation</u> |
| int | <u>translation</u> |

V.5.199.3Fields

center
 public static final int center
 center = 0

children
 public static final int children
 children = 1

rotation
 public static final int rotation
 rotation = 2

scale
 public static final int scale
 scale = 3

scaleOrientation
 public static final int scaleOrientation
 scaleOrientation = 4

translation
 public static final int translation
 translation = 5

V.5.200 org.iso.mpeg.mpegj.scene.EventOut.Transform2D

V.5.200.1Syntax

```
public static interface EventOut.Transform2D
```

V.5.200.2Description

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>center</u> |
| int | <u>rotationAngle</u> |
| int | <u>scale</u> |
| int | <u>scaleOrientation</u> |
| int | <u>translation</u> |

V.5.200.3Fields

center
 public static final int center
 center = 1

children
 public static final int children
 children = 0

rotationAngle

```

public static final int rotationAngle
rotationAngle = 2
scale
public static final int scale
scale = 3
scaleOrientation
public static final int scaleOrientation
scaleOrientation = 4
translation
public static final int translation
translation = 5

```

V.5.201 org.iso.mpeg.mpegj.scene.EventOut.Valuator**V.5.201.1 Syntax**

```
public static interface EventOut.Valuator
```

V.5.201.2 Description

| Member Summary | |
|----------------|----------------------|
| Fields | |
| int | <u>outSFBool</u> |
| int | <u>outSFColor</u> |
| int | <u>outMFColor</u> |
| int | <u>outSFFloat</u> |
| int | <u>outMFFloat</u> |
| int | <u>outSFInt32</u> |
| int | <u>outMFInt32</u> |
| int | <u>outSFRotation</u> |
| int | <u>outMFRotation</u> |
| int | <u>outSFString</u> |
| int | <u>outMFString</u> |
| int | <u>outSFTime</u> |
| int | <u>outSFVec2f</u> |
| int | <u>outMFVec2f</u> |
| int | <u>outSFVec3f</u> |
| int | <u>outMFVec3f</u> |
| int | <u>Factor1</u> |
| int | <u>Factor2</u> |
| int | <u>Factor3</u> |
| int | <u>Factor4</u> |
| int | <u>Offset1</u> |
| int | <u>Offset2</u> |
| int | <u>Offset3</u> |
| int | <u>Offset4</u> |
| int | <u>Sum</u> |

V.5.201.3 Fields**Factor1**

```
public static final int Factor1
```

Factor1 = 16

Factor2

```
public static final int Factor2
```

Factor2 = 17

Factor3

```
public static final int Factor3
```

Factor3 = 18

Factor4

```
public static final int Factor4
```

```

Factor4 = 19
Offset1
public static final int Offset1
Offset1 = 20
Offset2
public static final int Offset2
Offset2 = 21
Offset3
public static final int Offset3
Offset3 = 22
Offset4
public static final int Offset4
Offset4 = 23
outMFColor
public static final int outMFColor
outMFColor = 2
outMFFloat
public static final int outMFFloat
outMFFloat = 4
outMFInt32
public static final int outMFInt32
outMFInt32 = 6
outMFRotation
public static final int outMFRotation
outMFRotation = 8
outMFString
public static final int outMFString
outMFString = 10
outMFVec2f
public static final int outMFVec2f
outMFVec2f = 13
outMFVec3f
public static final int outMFVec3f
outMFVec3f = 15
outSFBool
public static final int outSFBool
outSFBool = 0
outSFCOLOR
public static final int outSFCOLOR
outSFCOLOR = 1
outSFFloat
public static final int outSFFloat
outSFFloat = 3
outSFInt32
public static final int outSFInt32
outSFInt32 = 5
outSFRotation
public static final int outSFRotation
outSFRotation = 7
outSFString
public static final int outSFString

```

```
outSFString = 9
outSFTime
public static final int outSFTime
outSFTime = 11
outSFVec2f
public static final int outSFVec2f
outSFVec2f = 12
outSFVec3f
public static final int outSFVec3f
outSFVec3f = 14
Sum
public static final int Sum
Sum = 24
```

V.5.202 org.iso.mpeg.mpegj.scene.EventOut.Viewpoint

V.5.202.1 Syntax

```
public static interface EventOut.Viewpoint
```

V.5.202.2 Description

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>fieldOfView</u> |
| int | <u>jump</u> |
| int | <u>orientation</u> |
| int | <u>position</u> |
| int | <u>bindTime</u> |
| int | <u>isBound</u> |

V.5.202.3 Fields

```
bindTime
public static final int bindTime
bindTime = 4
fieldOfView
public static final int fieldOfView
fieldOfView = 0
isBound
public static final int isBound
isBound = 5
jump
public static final int jump
jump = 1
orientation
public static final int orientation
orientation = 2
position
public static final int position
position = 3
```

V.5.203 org.iso.mpeg.mpegj.scene.EventOut.Viseme

V.5.203.1 Syntax

```
public static interface EventOut.Viseme
```

V.5.203.2 Description

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>viseme_select1</u> |
| int | <u>viseme_select2</u> |
| int | <u>viseme_blend</u> |
| int | <u>viseme_def</u> |

V.5.203.3 Fields

viseme_blend
 public static final int viseme_blend
 viseme_blend = 2

viseme_def
 public static final int viseme_def
 viseme_def = 3

viseme_select1
 public static final int viseme_select1
 viseme_select1 = 0

viseme_select2
 public static final int viseme_select2
 viseme_select2 = 1

V.5.204 org.iso.mpeg.mpegj.scene.EventOut.VisibilitySensor

V.5.204.1 Syntax

```
public static interface EventOut.VisibilitySensor
```

V.5.204.2 Description

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>enabled</u> |
| int | <u>size</u> |
| int | <u>enterTime</u> |
| int | <u>exitTime</u> |
| int | <u>isActive</u> |

V.5.204.3 Fields

center
 public static final int center
 center = 0

enabled
 public static final int enabled
 enabled = 1

enterTime
 public static final int enterTime
 enterTime = 3

exitTime
 public static final int exitTime
 exitTime = 4

isActive
 public static final int isActive
 isActive = 5

size
 public static final int size
 size = 2

V.5.205 org.iso.mpeg.mpegj.scene.EventOut.WorldInfo**V.5.205.1 Syntax**

```
public static interface EventOut.WorldInfo
```

V.5.205.2 Description**V.5.206 org.iso.mpeg.mpegj.scene.EventOutListener****V.5.206.1 Syntax**

```
public interface EventOutListener
```

V.5.206.2 Description

An interface to be implemented by objects that wish to receive eventOut notification from fields in the scene.

| Member Summary | |
|-----------------------|--|
| Methods | void notify(int, FieldValue) |

V.5.206.3 Methods**notify(int, FieldValue)**

```
public void notify(int, org.iso.mpeg.mpegj.scene.FieldValue)
```

Called by the scene graph manager when a new event out is triggered.

Parameters:

outID - contains the outID of the changed field.

newValue - contains the new value of the field.

See Also:

[org.iso.mpeg.mpegj.scene.EventOut](#)

V.5.207 org.iso.mpeg.mpegj.scene.Field**V.5.207.1 Syntax**

```
public interface Field
```

V.5.207.2 Description

An interface with inner classes defining the constants for the field defIDs of each node.

| Member Summary | |
|-----------------------|---|
| Inner Classes | <pre>static interface Field.Anchor static interface Field.AnimationStream static interface Field.Appearance static interface Field.AudioBuffer static interface Field.AudioClip static interface Field.AudioDelay static interface Field.AudioFX static interface Field.AudioMix static interface Field<audiosource< a=""> static interface Field.AudioSwitch static interface Field.Background static interface Field.Background2D static interface Field.Billboard static interface Field.Bitmap</audiosource<></pre> |

```

static interface Field.Box
static interface Field.Circle
static interface Field.Collision
static interface Field.Color
static interface Field.ColorInterpolator
static interface Field.CompositeTexture2D
static interface Field.CompositeTexture3D
static interface Field.Conditional
static interface Field.Cone
static interface Field.Coordinate
static interface Field.Coordinate2D
static interface Field.CoordinateInterpolator
static interface Field.CoordinateInterpolator2D
static interface Field.Curve2D
static interface Field.Cylinder
static interface Field.CylinderSensor
static interface Field.DirectionalLight
static interface Field.DiscSensor
static interface Field.ElevationGrid
static interface Field.Expression
static interface Field.Extrusion
static interface Field.Face
static interface Field.FaceDefMesh
static interface Field.FaceDefTables
static interface Field.FaceDefTransform
static interface Field.FAP
static interface Field.FDP
static interface Field.FIT
static interface Field.Fog
static interface Field.FontStyle
static interface Field.Form
static interface Field.Group
static interface Field.ImageTexture
static interface Field.IndexedFaceSet
static interface Field.IndexedFaceSet2D
static interface Field.IndexedLineSet
static interface Field.IndexedLineSet2D
static interface Field.Inline
static interface Field.LOD
static interface Field.Layer2D
static interface Field.Layer3D
static interface Field.Layout
static interface Field.LineProperties
static interface Field.ListeningPoint
static interface Field.Material
static interface Field.Material2D
static interface Field.MovieTexture
static interface Field.NavigationInfo
static interface Field.Normal
static interface Field.NormalInterpolator
static interface Field.OrderedGroup
static interface Field.OrientationInterpolator
static interface Field.PixelTexture
static interface Field.PlaneSensor
static interface Field.PlaneSensor2D
static interface Field.PointLight
static interface Field.PointSet
static interface Field.PointSet2D
static interface Field.PositionInterpolator
static interface Field.PositionInterpolator2D
static interface Field.ProximitySensor2D
static interface Field.ProximitySensor
static interface Field.QuantizationParameter
static interface Field.Rectangle
static interface Field.ScalarInterpolator
static interface Field.Script
static interface Field.Shape
static interface Field.Sound
static interface Field.Sound2D
static interface Field.Sphere
static interface Field.SphereSensor

```

| | |
|------------------|--------------------------------|
| static interface | <u>Field.SpotLight</u> |
| static interface | <u>Field.Switch</u> |
| static interface | <u>Field.TermCap</u> |
| static interface | <u>Field.Text</u> |
| static interface | <u>Field.TextureCoordinate</u> |
| static interface | <u>Field.TextureTransform</u> |
| static interface | <u>Field.TimeSensor</u> |
| static interface | <u>Field.TouchSensor</u> |
| static interface | <u>Field.Transform</u> |
| static interface | <u>Field.Transform2D</u> |
| static interface | <u>Field.Valuator</u> |
| static interface | <u>Field.WorldInfo</u> |

V.5.208 org.iso.mpeg.mpegj.scene.Field.Anchor**V.5.208.1 Syntax**

```
public static interface Field.Anchor
```

V.5.208.2 Description

An interface defining constants for the field defIDs of the Anchor node.

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>description</u> |
| int | <u>parameter</u> |
| int | <u>url</u> |

V.5.208.3 Fields**children**

```
public static final int children
```

The defID for the children field = 2.

description

```
public static final int description
```

The defID for the description field = 3.

parameter

```
public static final int parameter
```

The defID for the parameter field = 4.

url

```
public static final int url
```

The defID for the url field = 5.

V.5.209 org.iso.mpeg.mpegj.scene.Field.AnimationStream**V.5.209.1 Syntax**

```
public static interface Field.AnimationStream
```

V.5.209.2 Description

An interface defining constants for the field defIDs of the AnimationStream node.

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |

V.5.209.3Fields

loop

```
public static final int loop
```

The defID for the loop field = 0.

speed

```
public static final int speed
```

The defID for the speed field = 1.

startTime

```
public static final int startTime
```

The defID for the startTime field = 2.

stopTime

```
public static final int stopTime
```

The defID for the stopTime field = 3.

url

```
public static final int url
```

The defID for the url field = 4.

V.5.210 org.iso.mpeg.mpegj.scene.Field.Appearance

V.5.210.1 Syntax

```
public static interface Field.Appearance
```

V.5.210.2 Description

An interface defining constants for the field defIDs of the Appearance node.

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>material</u> |
| int | <u>texture</u> |
| int | <u>textureTransform</u> |

V.5.210.3Fields

material

```
public static final int material
```

The defID for the material field = 0.

texture

```
public static final int texture
```

The defID for the texture field = 1.

textureTransform

```
public static final int textureTransform
```

The defID for the textureTransform field = 2.

V.5.211 org.iso.mpeg.mpegj.scene.Field.AudioBuffer

V.5.211.1 Syntax

```
public static interface Field.AudioBuffer
```

V.5.211.2 Description

An interface defining constants for the field defIDs of the AudioBuffer node.

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>pitch</u> |

| | |
|-----|-------------------|
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>children</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |
| int | <u>length</u> |

V.5.211.3Fields

children

public static final int children

The defID for the children field = 4.

length

public static final int length

The defID for the length field = 7.

loop

public static final int loop

The defID for the loop field = 0.

numChan

public static final int numChan

The defID for the numChan field = 5.

phaseGroup

public static final int phaseGroup

The defID for the phaseGroup field = 6.

pitch

public static final int pitch

The defID for the pitch field = 1.

startTime

public static final int startTime

The defID for the startTime field = 2.

stopTime

public static final int stopTime

The defID for the stopTime field = 3.

V.5.212 org.iso.mpeg.mpegj.scene.Field.AudioClip

V.5.212.1Syntax

public static interface Field.AudioClip

V.5.212.2Description

An interface defining constants for the field defIDs of the AudioClip node.

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>description</u> |
| int | <u>loop</u> |
| int | <u>pitch</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |

V.5.212.3Fields

description

public static final int description

The defID for the description field = 0.

loop

```
public static final int loop
```

The defID for the loop field = 1.

pitch

```
public static final int pitch
```

The defID for the pitch field = 2.

startTime

```
public static final int startTime
```

The defID for the startTime field = 3.

stopTime

```
public static final int stopTime
```

The defID for the stopTime field = 4.

url

```
public static final int url
```

The defID for the url field = 5.

V.5.213 org.iso.mpeg.mpegj.scene.Field.AudioDelay

V.5.213.1 Syntax

```
public static interface Field.AudioDelay
```

V.5.213.2 Description

An interface defining constants for the field defIDs of the AudioDelay node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>delay</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.213.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

delay

```
public static final int delay
```

The defID for the delay field = 3.

numChan

```
public static final int numChan
```

The defID for the numChan field = 4.

phaseGroup

```
public static final int phaseGroup
```

The defID for the phaseGroup field = 5.

V.5.214 org.iso.mpeg.mpegj.scene.Field.AudioFX

V.5.214.1 Syntax

```
public static interface Field.AudioFX
```

V.5.214.2 Description

An interface defining constants for the field defIDs of the AudioFX node.

| Member Summary | |
|-----------------------|--|
| | |

| Fields | |
|--------|-------------------|
| int | <u>children</u> |
| int | <u>orch</u> |
| int | <u>score</u> |
| int | <u>params</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.214.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

numChan

```
public static final int numChan
```

The defID for the numChan field = 6.

orch

```
public static final int orch
```

The defID for the orch field = 3.

params

```
public static final int params
```

The defID for the params field = 5.

phaseGroup

```
public static final int phaseGroup
```

The defID for the phaseGroup field = 7.

score

```
public static final int score
```

The defID for the score field = 4.

V.5.215 org.iso.mpeg.mpegj.scene.Field.AudioMix

V.5.215.1 Syntax

```
public static interface Field.AudioMix
```

V.5.215.2 Description

An interface defining constants for the field defIDs of the AudioMix node.

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>numInputs</u> |
| int | <u>matrix</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.215.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

matrix

```
public static final int matrix
```

The defID for the matrix field = 4.

numChan

```
public static final int numChan
```

The defID for the numChan field = 5.

numInputs

```
public static final int numInputs
```

The defID for the numInputs field = 3.

phaseGroup

```
public static final int phaseGroup
```

The defID for the phaseGroup field = 6.

V.5.216 org.iso.mpeg.mpegj.scene.Field.AudioSource

V.5.216.1 Syntax

```
public static interface Field.AudioSource
```

V.5.216.2 Description

An interface defining constants for the field defIDs of the AudioSource node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>url</u> |
| int | <u>pitch</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.216.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

numChan

```
public static final int numChan
```

The defID for the numChan field = 8.

phaseGroup

```
public static final int phaseGroup
```

The defID for the phaseGroup field = 9.

pitch

```
public static final int pitch
```

The defID for the pitch field = 4.

speed

```
public static final int speed
```

The defID for the speed field = 5.

startTime

```
public static final int startTime
```

The defID for the startTime field = 6.

stopTime

```
public static final int stopTime
```

The defID for the stopTime field = 7.

url

```
public static final int url
```

The defID for the url field = 3.

V.5.217 org.iso.mpeg.mpegj.scene.Field.AudioSwitch**V.5.217.1 Syntax**

```
public static interface Field.AudioSwitch
```

V.5.217.2 Description

An interface defining constants for the field defIDs of the AudioSwitch node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>whichChoice</u> |
| int | <u>numChan</u> |
| int | <u>phaseGroup</u> |

V.5.217.3 Fields**children**

```
public static final int children
```

The defID for the children field = 2.

numChan

```
public static final int numChan
```

The defID for the numChan field = 4.

phaseGroup

```
public static final int phaseGroup
```

The defID for the phaseGroup field = 5.

whichChoice

```
public static final int whichChoice
```

The defID for the whichChoice field = 3.

V.5.218 org.iso.mpeg.mpegj.scene.Field.Background**V.5.218.1 Syntax**

```
public static interface Field.Background
```

V.5.218.2 Description

An interface defining constants for the field defIDs of the Background node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>groundAngle</u> |
| int | <u>groundColor</u> |
| int | <u>backUrl</u> |
| int | <u>bottomUrl</u> |
| int | <u>frontUrl</u> |
| int | <u>leftUrl</u> |
| int | <u>rightUrl</u> |
| int | <u>topUrl</u> |
| int | <u>skyAngle</u> |
| int | <u>skyColor</u> |

V.5.218.3 Fields**backUrl**

```
public static final int backUrl
```

The defID for the backUrl field = 3.

bottomUrl

```
public static final int bottomUrl
```

The defID for the bottomUrl field = 4.

frontUrl

```
public static final int frontUrl
```

The defID for the frontUrl field = 5.

groundAngle

```
public static final int groundAngle
```

The defID for the groundAngle field = 1.

groundColor

```
public static final int groundColor
```

The defID for the groundColor field = 2.

leftUrl

```
public static final int leftUrl
```

The defID for the leftUrl field = 6.

rightUrl

```
public static final int rightUrl
```

The defID for the rightUrl field = 7.

skyAngle

```
public static final int skyAngle
```

The defID for the skyAngle field = 9.

skyColor

```
public static final int skyColor
```

The defID for the skyColor field = 10.

topUrl

```
public static final int topUrl
```

The defID for the topUrl field = 8.

V.5.219 org.iso.mpeg.mpegj.scene.Field.Background2D

V.5.219.1 Syntax

```
public static interface Field.Background2D
```

V.5.219.2 Description

An interface defining constants for the field defIDs of the Background2D node.

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>backColor</u> |
| int | <u>url</u> |

V.5.219.3 Fields

backColor

```
public static final int backColor
```

The defID for the backColor field = 1.

url

```
public static final int url
```

The defID for the url field = 2.

V.5.220 org.iso.mpeg.mpegj.scene.Field.Billboard

V.5.220.1 Syntax

```
public static interface Field.Billboard
```

V.5.220.2Description

An interface defining constants for the field defIDs of the Billboard node.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>axisOfRotation</u> |

V.5.220.3Fields**axisOfRotation**

```
public static final int axisOfRotation
```

The defID for the axisOfRotation field = 3.

children

```
public static final int children
```

The defID for the children field = 2.

V.5.221 org.iso.mpeg.mpegj.scene.Field.Bitmap**V.5.221.1Syntax**

```
public static interface Field.Bitmap
```

V.5.221.2Description

An interface defining constants for the field defIDs of the Bitmap node.

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>scale</u> |

V.5.221.3Fields**scale**

```
public static final int scale
```

The defID for the scale field = 0.

V.5.222 org.iso.mpeg.mpegj.scene.Field.Box**V.5.222.1Syntax**

```
public static interface Field.Box
```

V.5.222.2Description

An interface defining constants for the field defIDs of the Box node.

| Member Summary | |
|-----------------------|-------------|
| Fields | |
| int | <u>size</u> |

V.5.222.3Fields**size**

```
public static final int size
```

The defID for the size field = 0.

V.5.223 org.iso.mpeg.mpegj.scene.Field.Circle**V.5.223.1 Syntax**

```
public static interface Field.Circle
```

V.5.223.2 Description

An interface defining constants for the field defIDs of the Circle node.

| Member Summary | |
|-----------------------|---------------|
| Fields | |
| int | <u>radius</u> |

V.5.223.3 Fields**radius**

```
public static final int radius
```

The defID for the radius field = 0.

V.5.224 org.iso.mpeg.mpegj.scene.Field.Collision**V.5.224.1 Syntax**

```
public static interface Field.Collision
```

V.5.224.2 Description

An interface defining constants for the field defIDs of the Collision node.

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>children</u> |
| int | <u>collide</u> |
| int | <u>proxy</u> |

V.5.224.3 Fields**children**

```
public static final int children
```

The defID for the children field = 2.

collide

```
public static final int collide
```

The defID for the collide field = 3.

proxy

```
public static final int proxy
```

The defID for the proxy field = 4.

V.5.225 org.iso.mpeg.mpegj.scene.Field.Color**V.5.225.1 Syntax**

```
public static interface Field.Color
```

V.5.225.2 Description

An interface defining constants for the field defIDs of the Color node.

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>color</u> |

V.5.225.3Fields**color**

```
public static final int color
```

The defID for the color field = 0.

V.5.226 org.iso.mpeg.mpegj.scene.Field.ColorInterpolator**V.5.226.1Syntax**

```
public static interface Field.ColorInterpolator
```

V.5.226.2Description

An interface defining constants for the field defIDs of the ColorInterpolator node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.226.3Fields**key**

```
public static final int key
```

The defID for the key field = 1.

keyValue

```
public static final int keyValue
```

The defID for the keyValue field = 2.

V.5.227 org.iso.mpeg.mpegj.scene.Field.CompositeTexture2D**V.5.227.1Syntax**

```
public static interface Field.CompositeTexture2D
```

V.5.227.2Description

An interface defining constants for the field defIDs of the CompositeTexture2D node.

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>pixelWidth</u> |
| int | <u>pixelHeight</u> |
| int | <u>background</u> |
| int | <u>viewport</u> |

V.5.227.3Fields**background**

```
public static final int background
```

The defID for the background field = 5.

children

```
public static final int children
```

The defID for the children field = 2.

pixelHeight

```
public static final int pixelHeight
```

The defID for the pixelHeight field = 4.

pixelWidth

```
public static final int pixelWidth
```

The defID for the pixelWidth field = 3.

viewport

```
public static final int viewport
```

The defID for the viewport field = 6.

V.5.228 org.iso.mpeg.mpegj.scene.Field.CompositeTexture3D

V.5.228.1 Syntax

```
public static interface Field.CompositeTexture3D
```

V.5.228.2 Description

An interface defining constants for the field defIDs of the CompositeTexture3D node.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>pixelWidth</u> |
| int | <u>pixelHeight</u> |
| int | <u>background</u> |
| int | <u>fog</u> |
| int | <u>navigationInfo</u> |
| int | <u>viewpoint</u> |

V.5.228.3 Fields

background

```
public static final int background
```

The defID for the background field = 5.

children

```
public static final int children
```

The defID for the children field = 2.

fog

```
public static final int fog
```

The defID for the fog field = 6.

navigationInfo

```
public static final int navigationInfo
```

The defID for the navigationInfo field = 7.

pixelHeight

```
public static final int pixelHeight
```

The defID for the pixelHeight field = 4.

pixelWidth

```
public static final int pixelWidth
```

The defID for the pixelWidth field = 3.

viewport

```
public static final int viewpoint
```

The defID for the viewpoint field = 8.

V.5.229 org.iso.mpeg.mpegj.scene.Field.Conditional

V.5.229.1 Syntax

```
public static interface Field.Conditional
```

V.5.229.2Description

An interface defining constants for the field defIDs of the Conditional node.

| Member Summary | |
|-----------------------|---------------|
| Fields | |
| int | <u>buffer</u> |

V.5.229.3Fields**buffer**

```
public static final int buffer
```

The defID for the buffer field = 2.

V.5.230 org.iso.mpeg.mpegj.scene.Field.Cone**V.5.230.1Syntax**

```
public static interface Field.Cone
```

V.5.230.2Description

An interface defining constants for the field defIDs of the Cone node.

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>bottomRadius</u> |
| int | <u>height</u> |
| int | <u>side</u> |
| int | <u>bottom</u> |

V.5.230.3Fields**bottom**

```
public static final int bottom
```

The defID for the bottom field = 3.

bottomRadius

```
public static final int bottomRadius
```

The defID for the bottomRadius field = 0.

height

```
public static final int height
```

The defID for the height field = 1.

side

```
public static final int side
```

The defID for the side field = 2.

V.5.231 org.iso.mpeg.mpegj.scene.Field.Coordinate**V.5.231.1Syntax**

```
public static interface Field.Coordinate
```

V.5.231.2Description

An interface defining constants for the field defIDs of the Coordinate node.

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.231.3Fields**point**

```
public static final int point
```

The defID for the point field = 0.

V.5.232 org.iso.mpeg.mpegj.scene.Field.Coordinate2D**V.5.232.1Syntax**

```
public static interface Field.Coordinate2D
```

V.5.232.2Description

An interface defining constants for the field defIDs of the Coordinate2D node.

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.232.3Fields**point**

```
public static final int point
```

The defID for the point field = 0.

V.5.233 org.iso.mpeg.mpegj.scene.Field.CoordinateInterpolator**V.5.233.1Syntax**

```
public static interface Field.CoordinateInterpolator
```

V.5.233.2Description

An interface defining constants for the field defIDs of the CoordinateInterpolator node.

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.233.3Fields**key**

```
public static final int key
```

The defID for the key field = 1.

keyValue

```
public static final int keyValue
```

The defID for the keyValue field = 2.

V.5.234 org.iso.mpeg.mpegj.scene.Field.CoordinateInterpolator2D**V.5.234.1Syntax**

```
public static interface Field.CoordinateInterpolator2D
```

V.5.234.2Description

An interface defining constants for the field defIDs of the CoordinateInterpolator2D node.

| Member Summary | |
|-----------------------|--|
| Fields | |

| | |
|-----|-----------------|
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.234.3Fields

key
public static final int key

The defID for the key field = 1.

keyValue
public static final int keyValue

The defID for the keyValue field = 2.

V.5.235 org.iso.mpeg.mpegj.scene.Field.Curve2D

V.5.235.1Syntax

```
public static interface Field.Curve2D
```

V.5.235.2Description

An interface defining constants for the field defIDs of the Curve2D node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>point</u> |
| int | <u>fineness</u> |
| int | <u>type</u> |

V.5.235.3Fields

fineness
public static final int fineness

The defID for the fineness field = 1.

point
public static final int point

The defID for the point field = 0.

type
public static final int type

The defID for the type field = 2.

V.5.236 org.iso.mpeg.mpegj.scene.Field.Cylinder

V.5.236.1Syntax

```
public static interface Field.Cylinder
```

V.5.236.2Description

An interface defining constants for the field defIDs of the Cylinder node.

| Member Summary | |
|----------------|---------------|
| Fields | |
| int | <u>bottom</u> |
| int | <u>height</u> |
| int | <u>radius</u> |
| int | <u>side</u> |
| int | <u>top</u> |

V.5.236.3Fields

bottom

```
public static final int bottom
```

The defID for the bottom field = 0.

height

```
public static final int height
```

The defID for the height field = 1.

radius

```
public static final int radius
```

The defID for the radius field = 2.

side

```
public static final int side
```

The defID for the side field = 3.

top

```
public static final int top
```

The defID for the top field = 4.

V.5.237 org.iso.mpeg.mpegj.scene.Field.CylinderSensor

V.5.237.1 Syntax

```
public static interface Field.CylinderSensor
```

V.5.237.2 Description

An interface defining constants for the field defIDs of the CylinderSensor node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>diskAngle</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |

V.5.237.3 Fields

autoOffset

```
public static final int autoOffset
```

The defID for the autoOffset field = 0.

diskAngle

```
public static final int diskAngle
```

The defID for the diskAngle field = 1.

enabled

```
public static final int enabled
```

The defID for the enabled field = 2.

maxAngle

```
public static final int maxAngle
```

The defID for the maxAngle field = 3.

minAngle

```
public static final int minAngle
```

The defID for the minAngle field = 4.

offset

```
public static final int offset
```

The defID for the offset field = 5.

V.5.238 org.iso.mpeg.mpegj.scene.Field.DirectionalLight**V.5.238.1 Syntax**

```
public static interface Field.DirectionalLight
```

V.5.238.2 Description

An interface defining constants for the field defIDs of the DirectionalLight node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>color</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>on</u> |

V.5.238.3 Fields**ambientIntensity**

```
public static final int ambientIntensity
```

The defID for the ambientIntensity field = 0.

color

```
public static final int color
```

The defID for the color field = 1.

direction

```
public static final int direction
```

The defID for the direction field = 2.

intensity

```
public static final int intensity
```

The defID for the intensity field = 3.

on

```
public static final int on
```

The defID for the on field = 4.

V.5.239 org.iso.mpeg.mpegj.scene.Field.DiscSensor**V.5.239.1 Syntax**

```
public static interface Field.DiscSensor
```

V.5.239.2 Description

An interface defining constants for the field defIDs of the DiscSensor node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxAngle</u> |
| int | <u>minAngle</u> |
| int | <u>offset</u> |

V.5.239.3 Fields**autoOffset**

```
public static final int autoOffset
```

The defID for the autoOffset field = 0.

enabled

```
public static final int enabled
```

The defID for the enabled field = 1.

maxAngle

```
public static final int maxAngle
```

The defID for the maxAngle field = 2.

minAngle

```
public static final int minAngle
```

The defID for the minAngle field = 3.

offset

```
public static final int offset
```

The defID for the offset field = 4.

V.5.240 org.iso.mpeg.mpegj.scene.Field.ElevationGrid**V.5.240.1 Syntax**

```
public static interface Field.ElevationGrid
```

V.5.240.2 Description

An interface defining constants for the field defIDs of the ElevationGrid node.

| Member Summary | |
|----------------|------------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |
| int | <u>height</u> |
| int | <u>ccw</u> |
| int | <u>colorPerVertex</u> |
| int | <u>creaseAngle</u> |
| int | <u>normalPerVertex</u> |
| int | <u>solid</u> |
| int | <u>xDimension</u> |
| int | <u>xSpacing</u> |
| int | <u>zDimension</u> |
| int | <u>zSpacing</u> |

V.5.240.3 Fields**ccw**

```
public static final int ccw
```

The defID for the ccw field = 5.

color

```
public static final int color
```

The defID for the color field = 1.

colorPerVertex

```
public static final int colorPerVertex
```

The defID for the colorPerVertex field = 6.

creaseAngle

```
public static final int creaseAngle
```

The defID for the creaseAngle field = 7.

height

```
public static final int height
```

The defID for the height field = 4.

normal

```
public static final int normal
```

The defID for the normal field = 2.

normalPerVertex

```
public static final int normalPerVertex
```

The defID for the normalPerVertex field = 8.

solid
public static final int solid

The defID for the solid field = 9.

texCoord
public static final int texCoord

The defID for the texCoord field = 3.

xDimension
public static final int xDimension

The defID for the xDimension field = 10.

xSpacing
public static final int xSpacing

The defID for the xSpacing field = 11.

zDimension
public static final int zDimension

The defID for the zDimension field = 12.

zSpacing
public static final int zSpacing

The defID for the zSpacing field = 13.

V.5.241 org.iso.mpeg.mpegj.scene.Field.Expression

V.5.241.1 Syntax

```
public static interface Field.Expression
```

V.5.241.2 Description

An interface defining constants for the field defIDs of the Expression node.

| Member Summary | |
|----------------|---------------------------------------|
| Fields | |
| int | expression_select1 |
| int | expression_intensity1 |
| int | expression_select2 |
| int | expression_intensity2 |
| int | init_face |
| int | expression_def |

V.5.241.3 Fields

expression_def
public static final int expression_def

The defID for the expression_def field = 5.

expression_intensity1
public static final int expression_intensity1

The defID for the expression_intensity1 field = 1.

expression_intensity2
public static final int expression_intensity2

The defID for the expression_intensity2 field = 3.

expression_select1
public static final int expression_select1

The defID for the expression_select1 field = 0.

expression_select2
public static final int expression_select2

The defID for the expression_select2 field = 2.

init_face
 public static final int init_face
 The defID for the init_face field = 4.

V.5.242 org.iso.mpeg.mpegj.scene.Field.Extrusion

V.5.242.1 Syntax

```
public static interface Field.Extrusion
```

V.5.242.2 Description

An interface defining constants for the field defIDs of the Extrusion node.

| Member Summary | |
|-----------------------|-------------------------------------|
| Fields | |
| int | <u>beginCap</u> |
| int | <u>ccw</u> |
| int | <u>convex</u> |
| int | <u>creaseAngle</u> |
| int | <u>crossSection</u> |
| int | <u>endCap</u> |
| int | <u>orientation</u> |
| int | <u>scale</u> |
| int | <u>solid</u> |
| int | <u>spine</u> |

V.5.242.3 Fields

beginCap

```
public static final int beginCap
```

The defID for the beginCap field = 4.

ccw

```
public static final int ccw
```

The defID for the ccw field = 5.

convex

```
public static final int convex
```

The defID for the convex field = 6.

creaseAngle

```
public static final int creaseAngle
```

The defID for the creaseAngle field = 7.

crossSection

```
public static final int crossSection
```

The defID for the crossSection field = 8.

endCap

```
public static final int endCap
```

The defID for the endCap field = 9.

orientation

```
public static final int orientation
```

The defID for the orientation field = 10.

scale

```
public static final int scale
```

The defID for the scale field = 11.

solid

```
public static final int solid
```

The defID for the solid field = 12.

spine

public static final int spine

The defID for the spine field = 13.

V.5.243 org.iso.mpeg.mpegj.scene.Field.Face

V.5.243.1 Syntax

public static interface Field.Face

V.5.243.2 Description

An interface defining constants for the field defIDs of the Face node.

| Member Summary | |
|-----------------------|---------------------|
| Fields | |
| int | <u>fap</u> |
| int | <u>fdp</u> |
| int | <u>fit</u> |
| int | <u>ttsSource</u> |
| int | <u>renderedFace</u> |

V.5.243.3 Fields

fap

public static final int fap

The defID for the fap field = 0.

fdp

public static final int fdp

The defID for the fdp field = 1.

fit

public static final int fit

The defID for the fit field = 2.

renderedFace

public static final int renderedFace

The defID for the renderedFace field = 4.

ttsSource

public static final int ttsSource

The defID for the ttsSource field = 3.

V.5.244 org.iso.mpeg.mpegj.scene.Field.FaceDefMesh

V.5.244.1 Syntax

public static interface Field.FaceDefMesh

V.5.244.2 Description

An interface defining constants for the field defIDs of the FaceDefMesh node.

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>faceSceneGraphNode</u> |
| int | <u>intervalBorders</u> |
| int | <u>coordIndex</u> |
| int | <u>displacements</u> |

V.5.244.3 Fields

coordIndex

public static final int coordIndex

The defID for the coordIndex field = 2.

displacements

```
public static final int displacements
```

The defID for the displacements field = 3.

faceSceneGraphNode

```
public static final int faceSceneGraphNode
```

The defID for the faceSceneGraphNode field = 0.

intervalBorders

```
public static final int intervalBorders
```

The defID for the intervalBorders field = 1.

V.5.245 org.iso.mpeg.mpegj.scene.Field.FaceDefTables

V.5.245.1 Syntax

```
public static interface Field.FaceDefTables
```

V.5.245.2 Description

An interface defining constants for the field defIDs of the FaceDefTables node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>fapID</u> |
| int | <u>highLevelSelect</u> |
| int | <u>faceDefMesh</u> |
| int | <u>faceDefTransform</u> |

V.5.245.3 Fields

faceDefMesh

```
public static final int faceDefMesh
```

The defID for the faceDefMesh field = 2.

faceDefTransform

```
public static final int faceDefTransform
```

The defID for the faceDefTransform field = 3.

fapID

```
public static final int fapID
```

The defID for the fapID field = 0.

highLevelSelect

```
public static final int highLevelSelect
```

The defID for the highLevelSelect field = 1.

V.5.246 org.iso.mpeg.mpegj.scene.Field.FaceDefTransform

V.5.246.1 Syntax

```
public static interface Field.FaceDefTransform
```

V.5.246.2 Description

An interface defining constants for the field defIDs of the FaceDefTransform node.

| Member Summary | |
|-----------------------|---------------------------|
| Fields | |
| int | <u>faceSceneGraphNode</u> |
| int | <u>fieldId</u> |
| int | <u>rotationDef</u> |
| int | <u>scaleDef</u> |
| int | <u>translationDef</u> |

V.5.246.3Fields**faceSceneGraphNode**

```
public static final int faceSceneGraphNode
```

The defID for the faceSceneGraphNode field = 0.

fieldId

```
public static final int fieldId
```

The defID for the fieldId field = 1.

rotationDef

```
public static final int rotationDef
```

The defID for the rotationDef field = 2.

scaleDef

```
public static final int scaleDef
```

The defID for the scaleDef field = 3.

translationDef

```
public static final int translationDef
```

The defID for the translationDef field = 4.

V.5.247 org.iso.mpeg.mpegj.scene.Field.FAP**V.5.247.1 Syntax**

```
public static interface Field.FAP
```

V.5.247.2 Description

An interface defining constants for the field defIDs of the FAP node.

| Member Summary | |
|----------------|---|
| Fields | <pre> int viseme int expression int open_jaw int lower_t_midlip int raise_b_midlip int stretch_l_corner int stretch_r_corner int lower_t_lip_lm int lower_t_lip_rm int lower_b_lip_lm int lower_b_lip_rm int raise_l_cornerlip int raise_r_cornerlip int thrust_jaw int shift_jaw int push_b_lip int push_t_lip int depress_chin int close_t_l_eyelid int close_t_r_eyelid int close_b_l_eyelid int close_b_r_eyelid int yaw_l_eyeball int yaw_r_eyeball int pitch_l_eyeball int pitch_r_eyeball int thrust_l_eyeball int thrust_r_eyeball int dilate_l_pupil int dilate_r_pupil int raise_l_i_eyebrow int raise_r_i_eyebrow int raise_l_m_eyebrow </pre> |

| | |
|-----|----------------------------|
| int | <u>raise_r_m_eyebrow</u> |
| int | <u>raise_l_o_eyebrow</u> |
| int | <u>raise_r_o_eyebrow</u> |
| int | <u>squeeze_l_eyebrow</u> |
| int | <u>squeeze_r_eyebrow</u> |
| int | <u>puff_l_cheek</u> |
| int | <u>puff_r_cheek</u> |
| int | <u>lift_l_cheek</u> |
| int | <u>lift_r_cheek</u> |
| int | <u>shift_tongue_tip</u> |
| int | <u>raise_tongue_tip</u> |
| int | <u>thrust_tongue_tip</u> |
| int | <u>raise_tongue</u> |
| int | <u>tongue_roll</u> |
| int | <u>head_pitch</u> |
| int | <u>head_yaw</u> |
| int | <u>head_roll</u> |
| int | <u>lower_t_midlip_o</u> |
| int | <u>raise_b_midlip_o</u> |
| int | <u>stretch_l_cornerlip</u> |
| int | <u>stretch_r_cornerlip</u> |
| int | <u>lower_t_lip_lm_o</u> |
| int | <u>lower_t_lip_rm_o</u> |
| int | <u>raise_b_lip_lm_o</u> |
| int | <u>raise_b_lip_rm_o</u> |
| int | <u>raise_l_cornerlip_o</u> |
| int | <u>raise_r_cornerlip_o</u> |
| int | <u>stretch_l_nose</u> |
| int | <u>stretch_r_nose</u> |
| int | <u>raise_nose</u> |
| int | <u>bend_nose</u> |
| int | <u>raise_l_ear</u> |
| int | <u>raise_r_ear</u> |
| int | <u>pull_l_ear</u> |
| int | <u>pull_r_ear</u> |

V.5.247.3 Fields

bend_nose
 public static final int bend_nose
 The defID for the bend_nose field = 63.

close_b_l_eyelid
 public static final int close_b_l_eyelid
 The defID for the close_b_l_eyelid field = 20.

close_b_r_eyelid
 public static final int close_b_r_eyelid
 The defID for the close_b_r_eyelid field = 21.

close_t_l_eyelid
 public static final int close_t_l_eyelid
 The defID for the close_t_l_eyelid field = 18.

close_t_r_eyelid
 public static final int close_t_r_eyelid
 The defID for the close_t_r_eyelid field = 19.

depress_chin
 public static final int depress_chin
 The defID for the depress_chin field = 17.

dilate_l_pupil
 public static final int dilate_l_pupil
 The defID for the dilate_l_pupil field = 28.

dilate_r_pupil
 public static final int dilate_r_pupil

The defID for the dilate_r_pupil field = 29.

expression

public static final int expression

The defID for the expression field = 1.

head_pitch

public static final int head_pitch

The defID for the head_pitch field = 47.

head_roll

public static final int head_roll

The defID for the head_roll field = 49.

head_yaw

public static final int head_yaw

The defID for the head_yaw field = 48.

lift_l_cheek

public static final int lift_l_cheek

The defID for the lift_l_cheek field = 40.

lift_r_cheek

public static final int lift_r_cheek

The defID for the lift_r_cheek field = 41.

lower_b_lip_lm

public static final int lower_b_lip_lm

The defID for the lower_b_lip_lm field = 9.

lower_b_lip_rm

public static final int lower_b_lip_rm

The defID for the lower_b_lip_rm field = 10.

lower_t_lip_lm

public static final int lower_t_lip_lm

The defID for the lower_t_lip_lm field = 7.

lower_t_lip_lm_o

public static final int lower_t_lip_lm_o

The defID for the lower_t_lip_lm_o field = 54.

lower_t_lip_rm

public static final int lower_t_lip_rm

The defID for the lower_t_lip_rm field = 8.

lower_t_lip_rm_o

public static final int lower_t_lip_rm_o

The defID for the lower_t_lip_rm_o field = 55.

lower_t_midlip

public static final int lower_t_midlip

The defID for the lower_t_midlip field = 3.

lower_t_midlip_o

public static final int lower_t_midlip_o

The defID for the lower_t_midlip_o field = 50.

open_jaw

public static final int open_jaw

The defID for the open_jaw field = 2.

pitch_l_eyeball

public static final int pitch_l_eyeball

The defID for the pitch_l_eyeball field = 24.

pitch_r_eyeball

public static final int pitch_r_eyeball

The defID for the pitch_r_eyeball field = 25.

puff_l_cheek
public static final int puff_l_cheek

The defID for the puff_l_cheek field = 38.

puff_r_cheek
public static final int puff_r_cheek

The defID for the puff_r_cheek field = 39.

pull_l_ear
public static final int pull_l_ear

The defID for the pull_l_ear field = 66.

pull_r_ear
public static final int pull_r_ear

The defID for the pull_r_ear field = 67.

push_b_lip
public static final int push_b_lip

The defID for the push_b_lip field = 15.

push_t_lip
public static final int push_t_lip

The defID for the push_t_lip field = 16.

raise_b_lip_lm_o
public static final int raise_b_lip_lm_o

The defID for the raise_b_lip_lm_o field = 56.

raise_b_lip_rm_o
public static final int raise_b_lip_rm_o

The defID for the raise_b_lip_rm_o field = 57.

raise_b_midlip
public static final int raise_b_midlip

The defID for the raise_b_midlip field = 4.

raise_b_midlip_o
public static final int raise_b_midlip_o

The defID for the raise_b_midlip_o field = 51.

raise_l_cornerlip
public static final int raise_l_cornerlip

The defID for the raise_l_cornerlip field = 11.

raise_l_cornerlip_o
public static final int raise_l_cornerlip_o

The defID for the raise_l_cornerlip_o field = 58.

raise_l_ear
public static final int raise_l_ear

The defID for the raise_l_ear field = 64.

raise_l_i_eyebrow
public static final int raise_l_i_eyebrow

The defID for the raise_l_i_eyebrow field = 30.

raise_l_m_eyebrow
public static final int raise_l_m_eyebrow

The defID for the raise_l_m_eyebrow field = 32.

raise_l_o_eyebrow
public static final int raise_l_o_eyebrow

The defID for the raise_l_o_eyebrow field = 34.

raise_nose
public static final int raise_nose

The defID for the raise_nose field = 62.

raise_r_cornerlip

```
public static final int raise_r_cornerlip
```

The defID for the raise_r_cornerlip field = 12.

raise_r_cornerlip_o

```
public static final int raise_r_cornerlip_o
```

The defID for the raise_r_cornerlip_o field = 59.

raise_r_ear

```
public static final int raise_r_ear
```

The defID for the raise_r_ear field = 65.

raise_r_i_eyebrow

```
public static final int raise_r_i_eyebrow
```

The defID for the raise_r_i_eyebrow field = 31.

raise_r_m_eyebrow

```
public static final int raise_r_m_eyebrow
```

The defID for the raise_r_m_eyebrow field = 33.

raise_r_o_eyebrow

```
public static final int raise_r_o_eyebrow
```

The defID for the raise_r_o_eyebrow field = 35.

raise_tongue

```
public static final int raise_tongue
```

The defID for the raise_tongue field = 45.

raise_tongue_tip

```
public static final int raise_tongue_tip
```

The defID for the raise_tongue_tip field = 43.

shift_jaw

```
public static final int shift_jaw
```

The defID for the shift_jaw field = 14.

shift_tongue_tip

```
public static final int shift_tongue_tip
```

The defID for the shift_tongue_tip field = 42.

squeeze_l_eyebrow

```
public static final int squeeze_l_eyebrow
```

The defID for the squeeze_l_eyebrow field = 36.

squeeze_r_eyebrow

```
public static final int squeeze_r_eyebrow
```

The defID for the squeeze_r_eyebrow field = 37.

stretch_l_corner

```
public static final int stretch_l_corner
```

The defID for the stretch_l_corner field = 5.

stretch_l_cornerlip

```
public static final int stretch_l_cornerlip
```

The defID for the stretch_l_cornerlip field = 52.

stretch_l_nose

```
public static final int stretch_l_nose
```

The defID for the stretch_l_nose field = 60.

stretch_r_corner

```
public static final int stretch_r_corner
```

The defID for the stretch_r_corner field = 6.

stretch_r_cornerlip

```
public static final int stretch_r_cornerlip
```

The defID for the stretch_r_cornerlip field = 53.

stretch_r_nose

```
public static final int stretch_r_nose
```

The defID for the stretch_r_nose field = 61.

thrust_jaw

```
public static final int thrust_jaw
```

The defID for the thrust_jaw field = 13.

thrust_l_eyeball

```
public static final int thrust_l_eyeball
```

The defID for the thrust_l_eyeball field = 26.

thrust_r_eyeball

```
public static final int thrust_r_eyeball
```

The defID for the thrust_r_eyeball field = 27.

thrust_tongue_tip

```
public static final int thrust_tongue_tip
```

The defID for the thrust_tongue_tip field = 44.

tongue_roll

```
public static final int tongue_roll
```

The defID for the tongue_roll field = 46.

viseme

```
public static final int viseme
```

The defID for the viseme field = 0.

yaw_l_eyeball

```
public static final int yaw_l_eyeball
```

The defID for the yaw_l_eyeball field = 22.

yaw_r_eyeball

```
public static final int yaw_r_eyeball
```

The defID for the yaw_r_eyeball field = 23.

V.5.248 org.iso.mpeg.mpegj.scene.Field.FDP

V.5.248.1 Syntax

```
public static interface Field.FDP
```

V.5.248.2 Description

An interface defining constants for the field defIDs of the FDP node.

| Member Summary | |
|-----------------------|---|
| Fields | |
| int | <u>featurePointsCoord</u> |
| int | <u>textureCoord</u> |
| int | <u>faceDefTables</u> |
| int | <u>faceSceneGraph</u> |
| int | <u>useOrthoTexture</u> |

V.5.248.3 Fields

faceDefTables

```
public static final int faceDefTables
```

The defID for the faceDefTables field = 2.

faceSceneGraph

```
public static final int faceSceneGraph
```

The defID for the faceSceneGraph field = 3.

featurePointsCoord

```
public static final int featurePointsCoord
```

The defID for the featurePointsCoord field = 0.

textureCoord

```
public static final int textureCoord
```

The defID for the textureCoord field = 1.

useOrthoTexture

```
public static final int useOrthoTexture
```

The defID for the useOrthoTexture field = 4.

V.5.249 org.iso.mpeg.mpegj.scene.Field.FIT**V.5.249.1 Syntax**

```
public static interface Field.FIT
```

V.5.249.2 Description

An interface defining constants for the field defIDs of the FIT node.

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>FAPs</u> |
| int | <u>Graph</u> |
| int | <u>numeratorExp</u> |
| int | <u>denominatorExp</u> |
| int | <u>numeratorImpulse</u> |
| int | <u>numeratorTerms</u> |
| int | <u>denominatorTerms</u> |
| int | <u>numeratorCoefs</u> |
| int | <u>denominatorCoefs</u> |

V.5.249.3 Fields**denominatorCoefs**

```
public static final int denominatorCoefs
```

The defID for the denominatorCoefs field = 8.

denominatorExp

```
public static final int denominatorExp
```

The defID for the denominatorExp field = 3.

denominatorTerms

```
public static final int denominatorTerms
```

The defID for the denominatorTerms field = 6.

FAPs

```
public static final int FAPs
```

The defID for the FAPs field = 0.

Graph

```
public static final int Graph
```

The defID for the Graph field = 1.

numeratorCoefs

```
public static final int numeratorCoefs
```

The defID for the numeratorCoefs field = 7.

numeratorExp

```
public static final int numeratorExp
```

The defID for the numeratorExp field = 2.

numeratorImpulse

```
public static final int numeratorImpulse
```

The defID for the numeratorImpulse field = 4.

numeratorTerms

```
public static final int numeratorTerms
```

The defID for the numeratorTerms field = 5.

V.5.250 org.iso.mpeg.mpegj.scene.Field.Fog**V.5.250.1 Syntax**

```
public static interface Field.Fog
```

V.5.250.2 Description

An interface defining constants for the field defIDs of the Fog node.

| Member Summary | |
|----------------|---------------------------------|
| Fields | |
| int | color |
| int | fogType |
| int | visibilityRange |

V.5.250.3 Fields**color**

```
public static final int color
```

The defID for the color field = 0.

fogType

```
public static final int fogType
```

The defID for the fogType field = 1.

visibilityRange

```
public static final int visibilityRange
```

The defID for the visibilityRange field = 2.

V.5.251 org.iso.mpeg.mpegj.scene.Field.FontStyle**V.5.251.1 Syntax**

```
public static interface Field.FontStyle
```

V.5.251.2 Description

An interface defining constants for the field defIDs of the FontStyle node.

| Member Summary | |
|----------------|-----------------------------|
| Fields | |
| int | family |
| int | horizontal |
| int | justify |
| int | language |
| int | leftToRight |
| int | size |
| int | spacing |
| int | style |
| int | topToBottom |

V.5.251.3 Fields**family**

```
public static final int family
```

The defID for the family field = 0.

horizontal

```
public static final int horizontal
```

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The defID for the horizontal field = 1.

justify

```
public static final int justify
```

The defID for the justify field = 2.

language

```
public static final int language
```

The defID for the language field = 3.

leftToRight

```
public static final int leftToRight
```

The defID for the leftToRight field = 4.

size

```
public static final int size
```

The defID for the size field = 5.

spacing

```
public static final int spacing
```

The defID for the spacing field = 6.

style

```
public static final int style
```

The defID for the style field = 7.

topToBottom

```
public static final int topToBottom
```

The defID for the topToBottom field = 8.

V.5.252 org.iso.mpeg.mpegj.scene.Field.Form

V.5.252.1 Syntax

```
public static interface Field.Form
```

V.5.252.2 Description

An interface defining constants for the field defIDs of the Form node.

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>size</u> |
| int | <u>groups</u> |
| int | <u>constraints</u> |
| int | <u>groupsIndex</u> |

V.5.252.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

constraints

```
public static final int constraints
```

The defID for the constraints field = 5.

groups

```
public static final int groups
```

The defID for the groups field = 4.

groupsIndex

```
public static final int groupsIndex
```

The defID for the groupsIndex field = 6.

size

```
public static final int size
```

The defID for the size field = 3.

V.5.253 org.iso.mpeg.mpegj.scene.Field.Group

V.5.253.1 Syntax

```
public static interface Field.Group
```

V.5.253.2 Description

An interface defining constants for the field defIDs of the Group node.

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>children</u> |

V.5.253.3 Fields

children

```
public static final int children
```

The defID for the children field = 2.

V.5.254 org.iso.mpeg.mpegj.scene.Field.ImageTexture

V.5.254.1 Syntax

```
public static interface Field.ImageTexture
```

V.5.254.2 Description

An interface defining constants for the field defIDs of the ImageTexture node.

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>url</u> |
| int | <u>repeatS</u> |
| int | <u>repeatT</u> |

V.5.254.3 Fields

repeatS

```
public static final int repeatS
```

The defID for the repeatS field = 1.

repeatT

```
public static final int repeatT
```

The defID for the repeatT field = 2.

url

```
public static final int url
```

The defID for the url field = 0.

V.5.255 org.iso.mpeg.mpegj.scene.Field.IndexedFaceSet

V.5.255.1 Syntax

```
public static interface Field.IndexedFaceSet
```

V.5.255.2 Description

An interface defining constants for the field defIDs of the IndexedFaceSet node.

| Member Summary | |
|-----------------------|------------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>normal</u> |
| int | <u>texCoord</u> |
| int | <u>ccw</u> |
| int | <u>colorIndex</u> |
| int | <u>colorPerVertex</u> |
| int | <u>convex</u> |
| int | <u>coordIndex</u> |
| int | <u>creaseAngle</u> |
| int | <u>normalIndex</u> |
| int | <u>normalPerVertex</u> |
| int | <u>solid</u> |
| int | <u>texCoordIndex</u> |

V.5.255.3 Fields

ccw

public static final int ccw

The defID for the ccw field = 8.

color

public static final int color

The defID for the color field = 4.

colorIndex

public static final int colorIndex

The defID for the colorIndex field = 9.

colorPerVertex

public static final int colorPerVertex

The defID for the colorPerVertex field = 10.

convex

public static final int convex

The defID for the convex field = 11.

coord

public static final int coord

The defID for the coord field = 5.

coordIndex

public static final int coordIndex

The defID for the coordIndex field = 12.

creaseAngle

public static final int creaseAngle

The defID for the creaseAngle field = 13.

normal

public static final int normal

The defID for the normal field = 6.

normalIndex

public static final int normalIndex

The defID for the normalIndex field = 14.

normalPerVertex

public static final int normalPerVertex

The defID for the normalPerVertex field = 15.

solid

public static final int solid

The defID for the solid field = 16.

texCoord

```
public static final int texCoord
The defID for the texCoord field = 7.

texCoordIndex
public static final int texCoordIndex
The defID for the texCoordIndex field = 17.
```

V.5.256 org.iso.mpeg.mpegj.scene.Field.IndexedFaceSet2D

V.5.256.1 Syntax

```
public static interface Field.IndexedFaceSet2D
```

V.5.256.2 Description

An interface defining constants for the field defIDs of the IndexedFaceSet2D node.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>texCoord</u> |
| int | <u>colorIndex</u> |
| int | <u>colorPerVertex</u> |
| int | <u>convex</u> |
| int | <u>coordIndex</u> |
| int | <u>texCoordIndex</u> |

V.5.256.3 Fields

color

```
public static final int color
```

The defID for the color field = 3.

colorIndex

```
public static final int colorIndex
```

The defID for the colorIndex field = 6.

colorPerVertex

```
public static final int colorPerVertex
```

The defID for the colorPerVertex field = 7.

convex

```
public static final int convex
```

The defID for the convex field = 8.

coord

```
public static final int coord
```

The defID for the coord field = 4.

coordIndex

```
public static final int coordIndex
```

The defID for the coordIndex field = 9.

texCoord

```
public static final int texCoord
```

The defID for the texCoord field = 5.

texCoordIndex

```
public static final int texCoordIndex
```

The defID for the texCoordIndex field = 10.

V.5.257 org.iso.mpeg.mpegj.scene.Field.IndexedLineSet**V.5.257.1 Syntax**

```
public static interface Field.IndexedLineSet
```

V.5.257.2 Description

An interface defining constants for the field defIDs of the IndexedLineSet node.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>colorIndex</u> |
| int | <u>colorPerVertex</u> |
| int | <u>coordIndex</u> |

V.5.257.3 Fields**color**

```
public static final int color
```

The defID for the color field = 2.

colorIndex

```
public static final int colorIndex
```

The defID for the colorIndex field = 4.

colorPerVertex

```
public static final int colorPerVertex
```

The defID for the colorPerVertex field = 5.

coord

```
public static final int coord
```

The defID for the coord field = 3.

coordIndex

```
public static final int coordIndex
```

The defID for the coordIndex field = 6.

V.5.258 org.iso.mpeg.mpegj.scene.Field.IndexedLineSet2D**V.5.258.1 Syntax**

```
public static interface Field.IndexedLineSet2D
```

V.5.258.2 Description

An interface defining constants for the field defIDs of the IndexedLineSet2D node.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |
| int | <u>colorIndex</u> |
| int | <u>colorPerVertex</u> |
| int | <u>coordIndex</u> |

V.5.258.3 Fields**color**

```
public static final int color
```

The defID for the color field = 2.

colorIndex

```
public static final int colorIndex
The defID for the colorIndex field = 4.
```

colorPerVertex
public static final int colorPerVertex

The defID for the colorPerVertex field = 5.

coord
public static final int coord

The defID for the coord field = 3.

coordIndex
public static final int coordIndex

The defID for the coordIndex field = 6.

V.5.259 org.iso.mpeg.mpegj.scene.Field.Inline

V.5.259.1 Syntax

```
public static interface Field.Inline
```

V.5.259.2 Description

An interface defining constants for the field defIDs of the Inline node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | int url |

V.5.259.3 Fields

url
public static final int url

The defID for the url field = 0.

V.5.260 org.iso.mpeg.mpegj.scene.Field.Layer2D

V.5.260.1 Syntax

```
public static interface Field.Layer2D
```

V.5.260.2 Description

An interface defining constants for the field defIDs of the Layer2D node.

| Member Summary | |
|-----------------------|--|
| Fields | int children int size int background int viewport |

V.5.260.3 Fields

background
public static final int background

The defID for the background field = 4.

children
public static final int children

The defID for the children field = 2.

size
public static final int size

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The defID for the size field = 3.

viewport

```
public static final int viewport
```

The defID for the viewpoint field = 5.

V.5.261 org.iso.mpeg.mpegj.scene.Field.Layer3D

V.5.261.1 Syntax

```
public static interface Field.Layer3D
```

V.5.261.2 Description

An interface defining constants for the field defIDs of the Layer3D node.

| Member Summary | |
|----------------|--------------------------------|
| Fields | |
| int | children |
| int | size |
| int | background |
| int | fog |
| int | navigationInfo |
| int | viewpoint |

V.5.261.3 Fields

background

```
public static final int background
```

The defID for the background field = 4.

children

```
public static final int children
```

The defID for the children field = 2.

fog

```
public static final int fog
```

The defID for the fog field = 5.

navigationInfo

```
public static final int navigationInfo
```

The defID for the navigationInfo field = 6.

size

```
public static final int size
```

The defID for the size field = 3.

viewpoint

```
public static final int viewpoint
```

The defID for the viewpoint field = 7.

V.5.262 org.iso.mpeg.mpegj.scene.Field.Layout

V.5.262.1 Syntax

```
public static interface Field.Layout
```

V.5.262.2 Description

An interface defining constants for the field defIDs of the Layout node.

| Member Summary | |
|----------------|--------------------------|
| Fields | |
| int | children |
| int | wrap |
| int | size |

| | |
|-----|-----------------------|
| int | <u>horizontal</u> |
| int | <u>justify</u> |
| int | <u>leftToRight</u> |
| int | <u>topToBottom</u> |
| int | <u>spacing</u> |
| int | <u>smoothScroll</u> |
| int | <u>loop</u> |
| int | <u>scrollVertical</u> |
| int | <u>scrollRate</u> |

V.5.262.3 Fields

children

public static final int children

The defID for the children field = 2.

horizontal

public static final int horizontal

The defID for the horizontal field = 5.

justify

public static final int justify

The defID for the justify field = 6.

leftToRight

public static final int leftToRight

The defID for the leftToRight field = 7.

loop

public static final int loop

The defID for the loop field = 11.

scrollRate

public static final int scrollRate

The defID for the scrollRate field = 13.

scrollVertical

public static final int scrollVertical

The defID for the scrollVertical field = 12.

size

public static final int size

The defID for the size field = 4.

smoothScroll

public static final int smoothScroll

The defID for the smoothScroll field = 10.

spacing

public static final int spacing

The defID for the spacing field = 9.

topToBottom

public static final int topToBottom

The defID for the topToBottom field = 8.

wrap

public static final int wrap

The defID for the wrap field = 3.

V.5.263 org.iso.mpeg.mpegj.scene.Field.LineProperties

V.5.263.1 Syntax

```
public static interface Field.LineProperties
```

V.5.263.2 Description

An interface defining constants for the field defIDs of the LineProperties node.

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>lineColor</u> |
| int | <u>lineStyle</u> |
| int | <u>width</u> |

V.5.263.3 Fields**lineColor**

```
public static final int lineColor
```

The defID for the lineColor field = 0.

lineStyle

```
public static final int lineStyle
```

The defID for the lineStyle field = 1.

width

```
public static final int width
```

The defID for the width field = 2.

V.5.264 org.iso.mpeg.mpegj.scene.Field.ListeningPoint**V.5.264.1 Syntax**

```
public static interface Field.ListeningPoint
```

V.5.264.2 Description

An interface defining constants for the field defIDs of the ListeningPoint node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>jump</u> |
| int | <u>orientation</u> |
| int | <u>position</u> |
| int | <u>description</u> |

V.5.264.3 Fields**description**

```
public static final int description
```

The defID for the description field = 4.

jump

```
public static final int jump
```

The defID for the jump field = 1.

orientation

```
public static final int orientation
```

The defID for the orientation field = 2.

position

```
public static final int position
```

The defID for the position field = 3.

V.5.265 org.iso.mpeg.mpegj.scene.Field.LOD**V.5.265.1 Syntax**

```
public static interface Field.LOD
```

V.5.265.2Description

An interface defining constants for the field defIDs of the LOD node.

| Member Summary | |
|-----------------------|---------------|
| Fields | |
| int | <u>level</u> |
| int | <u>center</u> |
| int | <u>range</u> |

V.5.265.3Fields

center

public static final int center

The defID for the center field = 1.

level

public static final int level

The defID for the level field = 0.

range

public static final int range

The defID for the range field = 2.

V.5.266 org.iso.mpeg.mpegj.scene.Field.Material

V.5.266.1Syntax

```
public static interface Field.Material
```

V.5.266.2Description

An interface defining constants for the field defIDs of the Material node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>diffuseColor</u> |
| int | <u>emissiveColor</u> |
| int | <u>shininess</u> |
| int | <u>specularColor</u> |
| int | <u>transparency</u> |

V.5.266.3Fields

ambientIntensity

public static final int ambientIntensity

The defID for the ambientIntensity field = 0.

diffuseColor

public static final int diffuseColor

The defID for the diffuseColor field = 1.

emissiveColor

public static final int emissiveColor

The defID for the emissiveColor field = 2.

shininess

public static final int shininess

The defID for the shininess field = 3.

specularColor

public static final int specularColor

The defID for the specularColor field = 4.

transparency

```
public static final int transparency
```

The defID for the transparency field = 5.

V.5.267 org.iso.mpeg.mpegj.scene.Field.Material2D**V.5.267.1 Syntax**

```
public static interface Field.Material2D
```

V.5.267.2 Description

An interface defining constants for the field defIDs of the Material2D node.

| Member Summary | |
|----------------|----------------------|
| Fields | |
| int | <u>emissiveColor</u> |
| int | <u>filled</u> |
| int | <u>lineProps</u> |
| int | <u>transparency</u> |

V.5.267.3 Fields**emissiveColor**

```
public static final int emissiveColor
```

The defID for the emissiveColor field = 0.

filled

```
public static final int filled
```

The defID for the filled field = 1.

lineProps

```
public static final int lineProps
```

The defID for the lineProps field = 2.

transparency

```
public static final int transparency
```

The defID for the transparency field = 3.

V.5.268 org.iso.mpeg.mpegj.scene.Field.MovieTexture**V.5.268.1 Syntax**

```
public static interface Field.MovieTexture
```

V.5.268.2 Description

An interface defining constants for the field defIDs of the MovieTexture node.

| Member Summary | |
|----------------|------------------|
| Fields | |
| int | <u>loop</u> |
| int | <u>speed</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |
| int | <u>url</u> |
| int | <u>repeats</u> |
| int | <u>repeatT</u> |

V.5.268.3 Fields**loop**

```
public static final int loop
```

The defID for the loop field = 0.

repeatS

```
public static final int repeatS
```

The defID for the repeatS field = 5.

repeatT

```
public static final int repeatT
```

The defID for the repeatT field = 6.

speed

```
public static final int speed
```

The defID for the speed field = 1.

startTime

```
public static final int startTime
```

The defID for the startTime field = 2.

stopTime

```
public static final int stopTime
```

The defID for the stopTime field = 3.

url

```
public static final int url
```

The defID for the url field = 4.

V.5.269 org.iso.mpeg.mpegj.scene.Field.NavigationInfo

V.5.269.1 Syntax

```
public static interface Field.NavigationInfo
```

V.5.269.2 Description

An interface defining constants for the field defIDs of the NavigationInfo node.

| Member Summary | |
|----------------|---------------------------------|
| Fields | |
| int | avatarSize |
| int | headlight |
| int | speed |
| int | type |
| int | visibilityLimit |

V.5.269.3 Fields

avatarSize

```
public static final int avatarSize
```

The defID for the avatarSize field = 1.

headlight

```
public static final int headlight
```

The defID for the headlight field = 2.

speed

```
public static final int speed
```

The defID for the speed field = 3.

type

```
public static final int type
```

The defID for the type field = 4.

visibilityLimit

```
public static final int visibilityLimit
```

The defID for the visibilityLimit field = 5.

V.5.270 org.iso.mpeg.mpegj.scene.Field.Normal**V.5.270.1 Syntax**

```
public static interface Field.Normal
```

V.5.270.2 Description

An interface defining constants for the field defIDs of the Normal node.

| Member Summary | |
|----------------|---------------|
| Fields | |
| int | <u>vector</u> |

V.5.270.3 Fields**vector**

```
public static final int vector
```

The defID for the vector field = 0.

V.5.271 org.iso.mpeg.mpegj.scene.Field.NormalInterpolator**V.5.271.1 Syntax**

```
public static interface Field.NormalInterpolator
```

V.5.271.2 Description

An interface defining constants for the field defIDs of the NormalInterpolator node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.271.3 Fields**key**

```
public static final int key
```

The defID for the key field = 1.

keyValue

```
public static final int keyValue
```

The defID for the keyValue field = 2.

V.5.272 org.iso.mpeg.mpegj.scene.Field.OrderedGroup**V.5.272.1 Syntax**

```
public static interface Field.OrderedGroup
```

V.5.272.2 Description

An interface defining constants for the field defIDs of the OrderedGroup node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>children</u> |
| int | <u>order</u> |

V.5.272.3 Fields**children**

```
public static final int children
```

The defID for the children field = 2.

order

```
public static final int order
```

The defID for the order field = 3.

V.5.273 org.iso.mpeg.mpegj.scene.Field.OrientationInterpolator

V.5.273.1 Syntax

```
public static interface Field.OrientationInterpolator
```

V.5.273.2 Description

An interface defining constants for the field defIDs of the OrientationInterpolator node.

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.273.3 Fields

key

```
public static final int key
```

The defID for the key field = 1.

keyValue

```
public static final int keyValue
```

The defID for the keyValue field = 2.

V.5.274 org.iso.mpeg.mpegj.scene.Field.PixelTexture

V.5.274.1 Syntax

```
public static interface Field.PixelTexture
```

V.5.274.2 Description

An interface defining constants for the field defIDs of the PixelTexture node.

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>image</u> |
| int | <u>repeatS</u> |
| int | <u>repeatT</u> |

V.5.274.3 Fields

image

```
public static final int image
```

The defID for the image field = 0.

repeatS

```
public static final int repeatS
```

The defID for the repeatS field = 1.

repeatT

```
public static final int repeatT
```

The defID for the repeatT field = 2.

V.5.275 org.iso.mpeg.mpegj.scene.Field.PlaneSensor**V.5.275.1 Syntax**

```
public static interface Field.PlaneSensor
```

V.5.275.2 Description

An interface defining constants for the field defIDs of the PlaneSensor node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |

V.5.275.3 Fields**autoOffset**

```
public static final int autoOffset
```

The defID for the autoOffset field = 0.

enabled

```
public static final int enabled
```

The defID for the enabled field = 1.

maxPosition

```
public static final int maxPosition
```

The defID for the maxPosition field = 2.

minPosition

```
public static final int minPosition
```

The defID for the minPosition field = 3.

offset

```
public static final int offset
```

The defID for the offset field = 4.

V.5.276 org.iso.mpeg.mpegj.scene.Field.PlaneSensor2D**V.5.276.1 Syntax**

```
public static interface Field.PlaneSensor2D
```

V.5.276.2 Description

An interface defining constants for the field defIDs of the PlaneSensor2D node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>maxPosition</u> |
| int | <u>minPosition</u> |
| int | <u>offset</u> |

V.5.276.3 Fields**autoOffset**

```
public static final int autoOffset
```

The defID for the autoOffset field = 0.

enabled

```
public static final int enabled
The defID for the enabled field = 1.

maxPosition
public static final int maxPosition
The defID for the maxPosition field = 2.

minPosition
public static final int minPosition
The defID for the minPosition field = 3.

offset
public static final int offset
The defID for the offset field = 4.
```

V.5.277 org.iso.mpeg.mpegj.scene.Field.PointLight

V.5.277.1 Syntax

```
public static interface Field.PointLight
```

V.5.277.2 Description

An interface defining constants for the field defIDs of the PointLight node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>color</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.277.3 Fields

ambientIntensity

```
public static final int ambientIntensity
```

The defID for the ambientIntensity field = 0.

attenuation

```
public static final int attenuation
```

The defID for the attenuation field = 1.

color

```
public static final int color
```

The defID for the color field = 2.

intensity

```
public static final int intensity
```

The defID for the intensity field = 3.

location

```
public static final int location
```

The defID for the location field = 4.

on

```
public static final int on
```

The defID for the on field = 5.

radius

```
public static final int radius
```

The defID for the radius field = 6.

V.5.278 org.iso.mpeg.mpegj.scene.Field.PointSet

V.5.278.1 Syntax

```
public static interface Field.PointSet
```

V.5.278.2 Description

An interface defining constants for the field defIDs of the PointSet node.

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.278.3 Fields

color

```
public static final int color
```

The defID for the color field = 0.

coord

```
public static final int coord
```

The defID for the coord field = 1.

V.5.279 org.iso.mpeg.mpegj.scene.Field.PointSet2D

V.5.279.1 Syntax

```
public static interface Field.PointSet2D
```

V.5.279.2 Description

An interface defining constants for the field defIDs of the PointSet2D node.

| Member Summary | |
|----------------|--------------|
| Fields | |
| int | <u>color</u> |
| int | <u>coord</u> |

V.5.279.3 Fields

color

```
public static final int color
```

The defID for the color field = 0.

coord

```
public static final int coord
```

The defID for the coord field = 1.

V.5.280 org.iso.mpeg.mpegj.scene.Field.PositionInterpolator

V.5.280.1 Syntax

```
public static interface Field.PositionInterpolator
```

V.5.280.2 Description

An interface defining constants for the field defIDs of the PositionInterpolator node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.280.3Fields

key

public static final int key

The defID for the key field = 1.

keyValue

public static final int keyValue

The defID for the keyValue field = 2.

V.5.281 org.iso.mpeg.mpegj.scene.Field.PositionInterpolator2D

V.5.281.1Syntax

public static interface Field.PositionInterpolator2D

V.5.281.2Description

An interface defining constants for the field defIDs of the PositionInterpolator2D node.

| Member Summary | |
|-----------------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.281.3Fields

key

public static final int key

The defID for the key field = 1.

keyValue

public static final int keyValue

The defID for the keyValue field = 2.

V.5.282 org.iso.mpeg.mpegj.scene.Field.ProximitySensor

V.5.282.1Syntax

public static interface Field.ProximitySensor

V.5.282.2Description

An interface defining constants for the field defIDs of the ProximitySensor node.

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |

V.5.282.3Fields

center

public static final int center

The defID for the center field = 0.

enabled

public static final int enabled

The defID for the enabled field = 2.

size

public static final int size

The defID for the size field = 1.

V.5.283 org.iso.mpeg.mpegj.scene.Field.ProximitySensor2D

V.5.283.1 Syntax

```
public static interface Field.ProximitySensor2D
```

V.5.283.2 Description

An interface defining constants for the field defIDs of the ProximitySensor2D node.

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>center</u> |
| int | <u>size</u> |
| int | <u>enabled</u> |

V.5.283.3 Fields

center

```
public static final int center
```

The defID for the center field = 0.

enabled

```
public static final int enabled
```

The defID for the enabled field = 2.

size

```
public static final int size
```

The defID for the size field = 1.

V.5.284 org.iso.mpeg.mpegj.scene.Field.QuantizationParameter

V.5.284.1 Syntax

```
public static interface Field.QuantizationParameter
```

V.5.284.2 Description

An interface defining constants for the field defIDs of the QuantizationParameter node.

| Member Summary | |
|-----------------------|--------------------------------|
| Fields | |
| int | <u>isLocal</u> |
| int | <u>position3DQuant</u> |
| int | <u>position3DMin</u> |
| int | <u>position3DMax</u> |
| int | <u>position3DNbBits</u> |
| int | <u>position2DOuant</u> |
| int | <u>position2DMin</u> |
| int | <u>position2DMax</u> |
| int | <u>position2DNbBits</u> |
| int | <u>drawOrderQuant</u> |
| int | <u>drawOrderMin</u> |
| int | <u>drawOrderMax</u> |
| int | <u>drawOrderNbBits</u> |
| int | <u>colorQuant</u> |
| int | <u>colorMin</u> |
| int | <u>colorMax</u> |
| int | <u>colorNbBits</u> |
| int | <u>textureCoordinateQuant</u> |
| int | <u>textureCoordinateMin</u> |
| int | <u>textureCoordinateMax</u> |
| int | <u>textureCoordinateNbBits</u> |
| int | <u>angleQuant</u> |
| int | <u>angleMin</u> |
| int | <u>angleMax</u> |

| | |
|-----|---------------------------|
| int | <u>angleNbBits</u> |
| int | <u>scaleQuant</u> |
| int | <u>scaleMin</u> |
| int | <u>scaleMax</u> |
| int | <u>scaleNbBits</u> |
| int | <u>keyQuant</u> |
| int | <u>keyMin</u> |
| int | <u>keyMax</u> |
| int | <u>keyNbBits</u> |
| int | <u>normalQuant</u> |
| int | <u>normalNbBits</u> |
| int | <u>sizeQuant</u> |
| int | <u>sizeMin</u> |
| int | <u>sizeMax</u> |
| int | <u>sizeNbBits</u> |
| int | <u>useEfficientCoding</u> |

V.5.284.3Fields

angleMax

public static final int angleMax

The defID for the angleMax field = 23.

angleMin

public static final int angleMin

The defID for the angleMin field = 22.

angleNbBits

public static final int angleNbBits

The defID for the angleNbBits field = 24.

angleQuant

public static final int angleQuant

The defID for the angleQuant field = 21.

colorMax

public static final int colorMax

The defID for the colorMax field = 15.

colorMin

public static final int colorMin

The defID for the colorMin field = 14.

colorNbBits

public static final int colorNbBits

The defID for the colorNbBits field = 16.

colorQuant

public static final int colorQuant

The defID for the colorQuant field = 13.

drawOrderMax

public static final int drawOrderMax

The defID for the drawOrderMax field = 11.

drawOrderMin

public static final int drawOrderMin

The defID for the drawOrderMin field = 10.

drawOrderNbBits

public static final int drawOrderNbBits

The defID for the drawOrderNbBits field = 12.

drawOrderQuant

public static final int drawOrderQuant

The defID for the drawOrderQuant field = 9.

isLocal

public static final int isLocal

The defID for the isLocal field = 0.

keyMax

public static final int keyMax

The defID for the keyMax field = 31.

keyMin

public static final int keyMin

The defID for the keyMin field = 30.

keyNbBits

public static final int keyNbBits

The defID for the keyNbBits field = 32.

keyQuant

public static final int keyQuant

The defID for the keyQuant field = 29.

normalNbBits

public static final int normalNbBits

The defID for the normalNbBits field = 34.

normalQuant

public static final int normalQuant

The defID for the normalQuant field = 33.

position2DMax

public static final int position2DMax

The defID for the position2DMax field = 7.

position2DMin

public static final int position2DMin

The defID for the position2DMin field = 6.

position2DNbBits

public static final int position2DNbBits

The defID for the position2DNbBits field = 8.

position2DQuant

public static final int position2DQuant

The defID for the position2DQuant field = 5.

position3DMax

public static final int position3DMax

The defID for the position3DMax field = 3.

position3DMin

public static final int position3DMin

The defID for the position3DMin field = 2.

position3DNbBits

public static final int position3DNbBits

The defID for the position3DNbBits field = 4.

position3DQuant

public static final int position3DQuant

The defID for the position3DQuant field = 1.

scaleMax

public static final int scaleMax

The defID for the scaleMax field = 27.

scaleMin

public static final int scaleMin

The defID for the scaleMin field = 26.

scaleNbBits

```

public static final int scaleNbBits
The defID for the scaleNbBits field = 28.

scaleQuant
public static final int scaleQuant
The defID for the scaleQuant field = 25.

sizeMax
public static final int sizeMax
The defID for the sizeMax field = 37.

sizeMin
public static final int sizeMin
The defID for the sizeMin field = 36.

sizeNbBits
public static final int sizeNbBits
The defID for the sizeNbBits field = 38.

sizeQuant
public static final int sizeQuant
The defID for the sizeQuant field = 35.

textureCoordinateMax
public static final int textureCoordinateMax
The defID for the textureCoordinateMax field = 19.

textureCoordinateMin
public static final int textureCoordinateMin
The defID for the textureCoordinateMin field = 18.

textureCoordinateNbBits
public static final int textureCoordinateNbBits
The defID for the textureCoordinateNbBits field = 20.

textureCoordinateQuant
public static final int textureCoordinateQuant
The defID for the textureCoordinateQuant field = 17.

useEfficientCoding
public static final int useEfficientCoding
The defID for the useEfficientCoding field = 39.

```

V.5.285 org.iso.mpeg.mpegj.scene.Field.Rectangle

V.5.285.1 Syntax

```
public static interface Field.Rectangle
```

V.5.285.2 Description

An interface defining constants for the field defIDs of the Rectangle node.

| Member Summary | |
|-----------------------|-------------|
| Fields | |
| int | <u>size</u> |

V.5.285.3 Fields

size
 public static final int size
 The defID for the size field = 0.

V.5.286 org.iso.mpeg.mpegj.scene.Field.ScalarInterpolator**V.5.286.1 Syntax**

```
public static interface Field.ScalarInterpolator
```

V.5.286.2 Description

An interface defining constants for the field defIDs of the ScalarInterpolator node.

| Member Summary | |
|----------------|-----------------|
| Fields | |
| int | <u>key</u> |
| int | <u>keyValue</u> |

V.5.286.3 Fields

key
 public static final int key

The defID for the key field = 1.

keyValue
 public static final int keyValue

The defID for the keyValue field = 2.

V.5.287 org.iso.mpeg.mpegj.scene.Field.Script**V.5.287.1 Syntax**

```
public static interface Field.Script
```

V.5.287.2 Description

An interface defining constants for the field defIDs of the Script node.

| Member Summary | |
|----------------|---------------------|
| Fields | |
| int | <u>url</u> |
| int | <u>directOutput</u> |
| int | <u>mustEvaluate</u> |

V.5.287.3 Fields

directOutput
 public static final int directOutput

The defID for the directOutput field = 1.

mustEvaluate
 public static final int mustEvaluate

The defID for the mustEvaluate field = 2.

url
 public static final int url

The defID for the url field = 0.

V.5.288 org.iso.mpeg.mpegj.scene.Field.Shape**V.5.288.1 Syntax**

```
public static interface Field.Shape
```

V.5.288.2 Description

An interface defining constants for the field defIDs of the Shape node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>appearance</u> |
| int | <u>geometry</u> |

V.5.288.3Fields

appearance

public static final int appearance

The defID for the appearance field = 0.

geometry

public static final int geometry

The defID for the geometry field = 1.

V.5.289 org.iso.mpeg.mpegj.scene.Field.Sound

V.5.289.1 Syntax

```
public static interface Field.Sound
```

V.5.289.2 Description

An interface defining constants for the field defIDs of the Sound node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>maxBack</u> |
| int | <u>maxFront</u> |
| int | <u>minBack</u> |
| int | <u>minFront</u> |
| int | <u>priority</u> |
| int | <u>source</u> |
| int | <u>spatialize</u> |

V.5.289.3Fields

direction

public static final int direction

The defID for the direction field = 0.

intensity

public static final int intensity

The defID for the intensity field = 1.

location

public static final int location

The defID for the location field = 2.

maxBack

public static final int maxBack

The defID for the maxBack field = 3.

maxFront

public static final int maxFront

The defID for the maxFront field = 4.

minBack

public static final int minBack

The defID for the minBack field = 5.

minFront

public static final int minFront

ISO/IEC 14496-1:2001(E)

The defID for the minFront field = 6.

priority

```
public static final int priority
```

The defID for the priority field = 7.

source

```
public static final int source
```

The defID for the source field = 8.

spatialize

```
public static final int spatialize
```

The defID for the spatialize field = 9.

V.5.290 org.iso.mpeg.mpegj.scene.Field.Sound2D

V.5.290.1 Syntax

```
public static interface Field.Sound2D
```

V.5.290.2 Description

An interface defining constants for the field defIDs of the Sound2D node.

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>source</u> |
| int | <u>spatialize</u> |

V.5.290.3 Fields

intensity

```
public static final int intensity
```

The defID for the intensity field = 0.

location

```
public static final int location
```

The defID for the location field = 1.

source

```
public static final int source
```

The defID for the source field = 2.

spatialize

```
public static final int spatialize
```

The defID for the spatialize field = 3.

V.5.291 org.iso.mpeg.mpegj.scene.Field.Sphere

V.5.291.1 Syntax

```
public static interface Field.Sphere
```

V.5.291.2 Description

An interface defining constants for the field defIDs of the Sphere node.

| Member Summary | |
|----------------|---------------|
| Fields | |
| int | <u>radius</u> |

V.5.291.3Fields

radius

```
public static final int radius
```

The defID for the radius field = 0.

V.5.292 org.iso.mpeg.mpegj.scene.Field.SphereSensor

V.5.292.1Syntax

```
public static interface Field.SphereSensor
```

V.5.292.2Description

An interface defining constants for the field defIDs of the SphereSensor node.

| Member Summary | |
|----------------|-------------------|
| Fields | |
| int | <u>autoOffset</u> |
| int | <u>enabled</u> |
| int | <u>offset</u> |

V.5.292.3Fields

autoOffset

```
public static final int autoOffset
```

The defID for the autoOffset field = 0.

enabled

```
public static final int enabled
```

The defID for the enabled field = 1.

offset

```
public static final int offset
```

The defID for the offset field = 2.

V.5.293 org.iso.mpeg.mpegj.scene.Field.SpotLight

V.5.293.1Syntax

```
public static interface Field.SpotLight
```

V.5.293.2Description

An interface defining constants for the field defIDs of the SpotLight node.

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>ambientIntensity</u> |
| int | <u>attenuation</u> |
| int | <u>beamWidth</u> |
| int | <u>color</u> |
| int | <u>cutOffAngle</u> |
| int | <u>direction</u> |
| int | <u>intensity</u> |
| int | <u>location</u> |
| int | <u>on</u> |
| int | <u>radius</u> |

V.5.293.3Fields

ambientIntensity

```
public static final int ambientIntensity
```

The defID for the ambientIntensity field = 0.

attenuation

ISO/IEC 14496-1:2001(E)

```
public static final int attenuation
```

The defID for the attenuation field = 1.

beamWidth

```
public static final int beamWidth
```

The defID for the beamWidth field = 2.

color

```
public static final int color
```

The defID for the color field = 3.

cutOffAngle

```
public static final int cutOffAngle
```

The defID for the cutOffAngle field = 4.

direction

```
public static final int direction
```

The defID for the direction field = 5.

intensity

```
public static final int intensity
```

The defID for the intensity field = 6.

location

```
public static final int location
```

The defID for the location field = 7.

on

```
public static final int on
```

The defID for the on field = 8.

radius

```
public static final int radius
```

The defID for the radius field = 9.

V.5.294 org.iso.mpeg.mpegj.scene.Field.Switch

V.5.294.1 Syntax

```
public static interface Field.Switch
```

V.5.294.2 Description

An interface defining constants for the field defIDs of the Switch node.

| Member Summary | |
|----------------|--------------------|
| Fields | |
| int | <u>choice</u> |
| int | <u>whichChoice</u> |

V.5.294.3 Fields

choice

```
public static final int choice
```

The defID for the choice field = 0.

whichChoice

```
public static final int whichChoice
```

The defID for the whichChoice field = 1.

V.5.295 org.iso.mpeg.mpegj.scene.Field.TermCap

V.5.295.1 Syntax

```
public static interface Field.TermCap
```

V.5.295.2Description

An interface defining constants for the field defIDs of the TermCap node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>capability</u> |

V.5.295.3Fields

capability

public static final int capability

The defID for the capability field = 1.

V.5.296 org.iso.mpeg.mpegj.scene.Field.Text

V.5.296.1Syntax

```
public static interface Field.Text
```

V.5.296.2Description

An interface defining constants for the field defIDs of the Text node.

| Member Summary | |
|-----------------------|------------------|
| Fields | |
| int | <u>string</u> |
| int | <u>length</u> |
| int | <u>fontStyle</u> |
| int | <u>maxExtent</u> |

V.5.296.3Fields

fontStyle

public static final int fontStyle

The defID for the fontStyle field = 2.

length

public static final int length

The defID for the length field = 1.

maxExtent

public static final int maxExtent

The defID for the maxExtent field = 3.

string

public static final int string

The defID for the string field = 0.

V.5.297 org.iso.mpeg.mpegj.scene.Field.TextureCoordinate

V.5.297.1Syntax

```
public static interface Field.TextureCoordinate
```

V.5.297.2Description

An interface defining constants for the field defIDs of the TextureCoordinate node.

| Member Summary | |
|-----------------------|--------------|
| Fields | |
| int | <u>point</u> |

V.5.297.3Fields**point**

```
public static final int point
```

The defID for the point field = 0.

V.5.298 org.iso.mpeg.mpegj.scene.Field.TextureTransform**V.5.298.1Syntax**

```
public static interface Field.TextureTransform
```

V.5.298.2Description

An interface defining constants for the field defIDs of the TextureTransform node.

| Member Summary | |
|-----------------------|--------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>rotation</u> |
| int | <u>scale</u> |
| int | <u>translation</u> |

V.5.298.3Fields**center**

```
public static final int center
```

The defID for the center field = 0.

rotation

```
public static final int rotation
```

The defID for the rotation field = 1.

scale

```
public static final int scale
```

The defID for the scale field = 2.

translation

```
public static final int translation
```

The defID for the translation field = 3.

V.5.299 org.iso.mpeg.mpegj.scene.Field.TimeSensor**V.5.299.1Syntax**

```
public static interface Field.TimeSensor
```

V.5.299.2Description

An interface defining constants for the field defIDs of the TimeSensor node.

| Member Summary | |
|-----------------------|----------------------|
| Fields | |
| int | <u>cycleInterval</u> |
| int | <u>enabled</u> |
| int | <u>loop</u> |
| int | <u>startTime</u> |
| int | <u>stopTime</u> |

V.5.299.3Fields**cycleInterval**

```
public static final int cycleInterval
```

The defID for the cycleInterval field = 0.

enabled

```
public static final int enabled
```

The defID for the enabled field = 1.

loop

```
public static final int loop
```

The defID for the loop field = 2.

startTime

```
public static final int startTime
```

The defID for the startTime field = 3.

stopTime

```
public static final int stopTime
```

The defID for the stopTime field = 4.

V.5.300 org.iso.mpeg.mpegj.scene.Field.TouchSensor**V.5.300.1 Syntax**

```
public static interface Field.TouchSensor
```

V.5.300.2 Description

An interface defining constants for the field defIDs of the TouchSensor node.

| Member Summary | |
|-----------------------|----------------|
| Fields | |
| int | <u>enabled</u> |

V.5.300.3 Fields**enabled**

```
public static final int enabled
```

The defID for the enabled field = 0.

V.5.301 org.iso.mpeg.mpegj.scene.Field.Transform**V.5.301.1 Syntax**

```
public static interface Field.Transform
```

V.5.301.2 Description

An interface defining constants for the field defIDs of the Transform node.

| Member Summary | |
|-----------------------|-------------------------|
| Fields | |
| int | <u>center</u> |
| int | <u>children</u> |
| int | <u>rotation</u> |
| int | <u>scale</u> |
| int | <u>scaleOrientation</u> |
| int | <u>translation</u> |

V.5.301.3 Fields**center**

```
public static final int center
```

The defID for the center field = 2.

children

```
public static final int children
```

The defID for the children field = 3.

rotation

```
public static final int rotation
```

The defID for the rotation field = 4.

scale

```
public static final int scale
```

The defID for the scale field = 5.

scaleOrientation

```
public static final int scaleOrientation
```

The defID for the scaleOrientation field = 6.

translation

```
public static final int translation
```

The defID for the translation field = 7.

V.5.302 org.iso.mpeg.mpegj.scene.Field.Transform2D

V.5.302.1 Syntax

```
public static interface Field.Transform2D
```

V.5.302.2 Description

An interface defining constants for the field defIDs of the Transform2D node.

| Member Summary | |
|----------------|-------------------------|
| Fields | |
| int | <u>children</u> |
| int | <u>center</u> |
| int | <u>rotationAngle</u> |
| int | <u>scale</u> |
| int | <u>scaleOrientation</u> |
| int | <u>translation</u> |

V.5.302.3 Fields

center

```
public static final int center
```

The defID for the center field = 3.

children

```
public static final int children
```

The defID for the children field = 2.

rotationAngle

```
public static final int rotationAngle
```

The defID for the rotationAngle field = 4.

scale

```
public static final int scale
```

The defID for the scale field = 5.

scaleOrientation

```
public static final int scaleOrientation
```

The defID for the scaleOrientation field = 6.

translation

```
public static final int translation
```

The defID for the translation field = 7.

V.5.303 org.iso.mpeg.mpegj.scene.Field.Valuator**V.5.303.1 Syntax**

```
public static interface Field.Valuator
```

V.5.303.2 Description

An interface defining constants for the field defIDs of the Valuator node.

| Member Summary | |
|-----------------------|-------------------|
| Fields | |
| int | <u>Factor1</u> |
| int | <u>Factor2</u> |
| int | <u>Factor3</u> |
| int | <u>Factor4</u> |
| int | <u>Offset1</u> |
| int | <u>Offset2</u> |
| int | <u>Offset3</u> |
| int | <u>viseme_def</u> |

V.5.303.3 Fields**Factor1**

```
public static final int Factor1
```

The defID for the Factor1 field = 32.

Factor2

```
public static final int Factor2
```

The defID for the Factor2 field = 33.

Factor3

```
public static final int Factor3
```

The defID for the Factor3 field = 34.

Factor4

```
public static final int Factor4
```

The defID for the Factor4 field = 35.

Offset1

```
public static final int Offset1
```

The defID for the Offset1 field = 36.

Offset2

```
public static final int Offset2
```

The defID for the Offset2 field = 37.

Offset3

```
public static final int Offset3
```

The defID for the Offset3 field = 38.

viseme_def

```
public static final int viseme_def
```

The defID for the viseme_def field = 3.

V.5.304 org.iso.mpeg.mpegj.scene.Field.WorldInfo**V.5.304.1 Syntax**

```
public static interface Field.WorldInfo
```

V.5.304.2 Description

An interface defining constants for the field defIDs of the WorldInfo node.

| Member Summary | |
|-----------------------|--|
| | |

| Fields | | |
|--------|--------------|--|
| int | <u>info</u> | |
| int | <u>title</u> | |

V.5.304.3 Fields

info
public static final int info

The defID for the info field = 0.

title
public static final int title

The defID for the title field = 1.

V.5.305 org.iso.mpeg.mpegj.scene.FieldValue

V.5.305.1 Syntax

```
public interface FieldValue
```

All Known Subinterfaces:

```
org.iso.mpeg.mpegj.scene.MFColorFieldValue, org.iso.mpeg.mpegj.scene.MFFieldValue,
org.iso.mpeg.mpegj.scene.MFFloatFieldValue,
org.iso.mpeg.mpegj.scene.MFInt32FieldValue, org.iso.mpeg.mpegj.scene.MFNodeFieldValue,
org.iso.mpeg.mpegj.scene.MFRotationFieldValue,
org.iso.mpeg.mpegj.scene.MFStringFieldValue,
org.iso.mpeg.mpegj.scene.MFTimeFieldValue, org.iso.mpeg.mpegj.scene.MFVec2fFieldValue,
org.iso.mpeg.mpegj.scene.MFVec3fFieldValue, org.iso.mpeg.mpegj.scene.SFBoolFieldValue,
org.iso.mpeg.mpegj.scene.SFColorFieldValue,
org.iso.mpeg.mpegj.scene.SFFloatFieldValue,
org.iso.mpeg.mpegj.scene.SFInt32FieldValue, org.iso.mpeg.mpegj.scene.SFNodeFieldValue,
org.iso.mpeg.mpegj.scene.SFRotationFieldValue,
org.iso.mpeg.mpegj.scene.SFStringFieldValue,
org.iso.mpeg.mpegj.scene.SFTimeFieldValue, org.iso.mpeg.mpegj.scene.SFVec2fFieldValue,
org.iso.mpeg.mpegj.scene.SFVec3fFieldValue
```

V.5.305.2 Description

A tagging interface used to identify objects that can return field values.

V.5.306 org.iso.mpeg.mpegj.scene.InvalidNodeException

V.5.306.1 Syntax

```
public class InvalidNodeException extends org.iso.mpeg.mpegj.MPEGJException

java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.scene.InvalidNodeException
```

All Implemented Interfaces:

java.io.Serializable

V.5.306.2 Description

An exception used to indicate that an operation was attempted on a node that is no longer valid.

| Member Summary | |
|-----------------------|--|
| Constructors | <u>InvalidNodeException()</u> <u>InvalidNodeException(String)</u> |

V.5.306.3 Constructors

InvalidNodeException()

public InvalidNodeException()

Constructs an InvalidNodeException with no specified detail message.

InvalidNodeException(String)

public InvalidNodeException(java.lang.String)

Constructs an InvalidNodeException with a detailed message.

Parameters:

message - the detail message.

V.5.307 org.iso.mpeg.mpegj.scene.InvalidSceneException

V.5.307.1 Syntax

```
public class InvalidSceneException extends org.iso.mpeg.mpegj.MPEGJException
java.lang.Object
|
+--java.lang.Throwable
|
+--java.lang.Exception
|
+--org.iso.mpeg.mpegj.MPEGJException
|
+--org.iso.mpeg.mpegj.scene.InvalidSceneException
```

All Implemented Interfaces:

java.io.Serializable

V.5.307.2 Description

An exception used by this package to indicate that an operation was attempted on a Scene that is no longer valid.

V.5.308 org.iso.mpeg.mpegj.scene.MFColorFieldValue

V.5.308.1 Syntax

```
public interface MFColorFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.308.2 Description

An interface used for obtaining MFColor values.

| Member Summary | |
|-----------------------|---|
| Methods | <u>SFColorFieldValue[]</u> <u>getMFColorValue()</u> |

V.5.308.3 Methods**getMFColorValue()**

```
public org.iso.mpeg.mpegj.scene.SFColorFieldValue getMFColorValue()
```

Obtain the MFColor value.

Returns:

an array of SFColorFieldValue objects.

V.5.309 org.iso.mpeg.mpegj.scene.MFFieldValue**V.5.309.1 Syntax**

```
public interface MFFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Known Subinterfaces:

```
org.iso.mpeg.mpegj.scene.MFColorFieldValue,  

org.iso.mpeg.mpegj.scene.MFFloatFieldValue,  

org.iso.mpeg.mpegj.scene.MFInt32FieldValue, org.iso.mpeg.mpegj.scene.MFNodeFieldValue,  

org.iso.mpeg.mpegj.scene.MFRotationFieldValue,  

org.iso.mpeg.mpegj.scene.MFStringFieldValue,  

org.iso.mpeg.mpegj.scene.MFTimeFieldValue, org.iso.mpeg.mpegj.scene.MFVec2fFieldValue,  

org.iso.mpeg.mpegj.scene.MFVec3fFieldValue
```

All Superinterfaces:

```
org.iso.mpeg.mpegj.scene.FieldValue
```

V.5.309.2 Description

A tagging interface used to classify FieldValue objects that return compound values.

V.5.310 org.iso.mpeg.mpegj.scene.MFFloatFieldValue**V.5.310.1 Syntax**

```
public interface MFFloatFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

```
org.iso.mpeg.mpegj.scene.FieldValue, org.iso.mpeg.mpegj.scene.MFFieldValue
```

V.5.310.2 Description

An interface used for obtaining MFFloat values.

| Member Summary | |
|-----------------------|---|
| Methods | <code>SFFloatFieldValue[]</code> <code>getMFFloatValue()</code> |

V.5.310.3 Methods**getMFFloatValue()**

```
public org.iso.mpeg.mpegj.scene.SFFloatFieldValue getMFFloatValue()
```

Obtain the MFFloat value.

Returns:

an array of MFFloatFieldValue objects.

V.5.311 org.iso.mpeg.mpegj.scene.MFInt32FieldValue**V.5.311.1 Syntax**

```
public interface MFInt32FieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.311.2 Description

An interface used for obtaining MFInt32 values.

| Member Summary | |
|-----------------------|-----------------------------------|
| Methods | |
| SFInt32FieldValue[] | getMFInt32Value() |

V.5.311.3 Methods**getMFInt32Value()**

public [org.iso.mpeg.mpegj.scene.SFInt32FieldValue](#) getMFInt32Value()

Obtain the SFInt32 value.

Returns:

an array of SFInt32Value objects.

V.5.312 org.iso.mpeg.mpegj.scene.MFNodeFieldValue**V.5.312.1 Syntax**

public interface MFNodeFieldValue extends [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.312.2 Description

An interface used for obtaining MFNode values.

| Member Summary | |
|-----------------------|----------------------------------|
| Methods | |
| SFNodeFieldValue[] | getMFNodeValue() |

V.5.312.3 Methods**getMFNodeValue()**

public [org.iso.mpeg.mpegj.scene.SFNodeFieldValue](#) getMFNodeValue()

Obtain the MFNode value.

Returns:

an array of SFNodeFieldValue objects.

V.5.313 org.iso.mpeg.mpegj.scene.MFRotationFieldValue**V.5.313.1 Syntax**

public interface MFRotationFieldValue extends [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.313.2 Description

An interface used for obtaining MFRotation values.

| Member Summary | |
|------------------------|--------------------------------------|
| Methods | |
| SFRotationFieldValue[] | getMFRotationValue() |

V.5.313.3 Methods**getMFRotationValue()**

```
public org.iso.mpeg.mpegj.scene.SFRotationFieldValue getMFRotationValue()
```

Obtain the MFRotation value.

Returns:

an array of MFRotationFieldValue objects.

V.5.314 org.iso.mpeg.mpegj.scene.MFStringFieldValue**V.5.314.1 Syntax**

```
public interface MFStringFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.314.2 Description

An interface used for obtaining MFString values.

| Member Summary | |
|-----------------------|--|
| Methods | <code>SFStringFieldValue[] getMFStringValue()</code> |

V.5.314.3 Methods**getMFStringValue()**

```
public org.iso.mpeg.mpegj.scene.SFStringFieldValue getMFStringValue()
```

Obtain the MFString value.

Returns:

an array of SFStringFieldValue objects.

V.5.315 org.iso.mpeg.mpegj.scene.MFTimeFieldValue**V.5.315.1 Syntax**

```
public interface MFTimeFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.315.2 Description

An interface used for obtaining MFTime values.

| Member Summary | |
|-----------------------|--|
| Methods | <code>SFTimeFieldValue[] getMFTimeValue()</code> |

V.5.315.3 Methods**getMFTimeValue()**

```
public org.iso.mpeg.mpegj.scene.SFTimeFieldValue getMFTimeValue()
```

Obtain the MFTime value.

Returns:

an array of SFTimeFieldValue objects.

V.5.316 org.iso.mpeg.mpegj.scene.MFVec2fFieldValue**V.5.316.1 Syntax**

```
public interface MFVec2fFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.316.2 Description

An interface used for obtaining MFVec2f values.

| Member Summary | |
|-----------------------|-----------------------------------|
| Methods | |
| SFVec2fFieldValue[] | getMFVec2fValue() |

V.5.316.3 Methods**getMFVec2fValue()**

```
public org.iso.mpeg.mpegj.scene.SFVec2fFieldValue getMFVec2fValue()
```

Obtain the MFVec2f value.

Returns:

an array of SFVec2fFieldValue objects.

V.5.317 org.iso.mpeg.mpegj.scene.MFVec3fFieldValue**V.5.317.1 Syntax**

```
public interface MFVec3fFieldValue extends org.iso.mpeg.mpegj.scene.MFFieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#), [org.iso.mpeg.mpegj.scene.MFFieldValue](#)

V.5.317.2 Description

An interface used for obtaining MFVec3f values.

| Member Summary | |
|-----------------------|-----------------------------------|
| Methods | |
| SFVec3fFieldValue[] | getMFVec3fValue() |

V.5.317.3 Methods**getMFVec3fValue()**

```
public org.iso.mpeg.mpegj.scene.SFVec3fFieldValue getMFVec3fValue()
```

Obtain the MFVec3f value.

Returns:

an array of SFVec3fFieldValue objects.

V.5.318 org.iso.mpeg.mpegj.scene.NewNode**V.5.318.1 Syntax**

```
public interface NewNode extends org.iso.mpeg.mpegj.scene.NodeValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.NodeValue](#)

V.5.318.2 Description

An interface used to specify the creation of a new node.

| Member Summary | |
|-----------------------|-------------------------------|
| Methods | |
| int | getNodeType() |
| int | getNodeID() |
| FieldValue | getField(int) |

V.5.318.3 Methods**getField(int)**

```
public org.iso.mpeg.mpegj.scene.FieldValue getField(int)
```

Obtain the value of a field in the new node identified by the given defID, or null if the field has the default value. For example, the defID argument may be Field.Transform.translation, in which case the object returned shall implement the SFVec3fFieldValue interface.

Parameters:

defID - the field defID.

Returns:

the field value, or null for the default value.

Throws:

[org.iso.mpeg.mpegj.scene.BadParameterException](#) - if the defID is not a valid field defID.

See Also:

[org.iso.mpeg.mpegj.scene.Field](#)

getNodeID()

```
public int getNodeID()
```

Obtain the DEF identifier of the new node, or zero if the node does not have a DEF identifier.

Returns:

the DEF identifier, or zero if none.

getNodeType()

```
public int getNodeType()
```

Obtain the node type of the new node. For example, this method may return NodeType.Transform.

Returns:

the integer node type.

See Also:

[org.iso.mpeg.mpegj.scene.NodeType](#)

V.5.319 org.iso.mpeg.mpegj.scene.Node**V.5.319.1 Syntax**

```
public interface Node
```

V.5.319.2 Description

An interface that acts as a proxy for a BIFS node in the scene graph. Only nodes in the scene that have been instanced with DEF may have a Node proxy.

| Member Summary | |
|-----------------------|---|
| Methods | |
| void | sendEventIn(int, FieldValue) |
| FieldValue | getEventOut(int) |
| void | addEventOutListener(int, EventOutListener) |
| void | removeEventOutListener(int, EventOutListener) |
| int | getNodeType() |

V.5.319.3 Methods

addEventOutListener(int, EventOutListener)

public void addEventOutListener(int, [org.iso.mpeg.mpegj.scene.EventOutListener](#))

Install a listener for an eventOut or exposedField in this node of the scene graph.

Parameters:

outID - The outID of the field to be monitored.

listener - The listener to notify of changes.

Throws:

[org.iso.mpeg.mpegj.scene.BadParameterException](#) - Thrown if the selected field ID is not valid for this node.

[org.iso.mpeg.mpegj.scene.InvalidNodeException](#) - Thrown if the node is no longer valid (due to removal or replacement).

See Also:

[org.iso.mpeg.mpegj.scene.EventOut](#), [org.iso.mpeg.mpegj.scene.EventOutListener](#)

getEventOut(int)

public [org.iso.mpeg.mpegj.scene.FieldValue](#) getEventOut(int)

Reads the current value of an eventOut or exposedField in this node of the scene graph.

Parameters:

outID - The outID of the field to be read.

Returns:

a FieldValue containing the value read from the desired field.

Throws:

[org.iso.mpeg.mpegj.scene.BadParameterException](#) - Thrown if the selected field ID is not valid for this node.

[org.iso.mpeg.mpegj.scene.InvalidNodeException](#) - Thrown if the node is no longer valid (due to removal or replacement).

See Also:

[org.iso.mpeg.mpegj.scene.EventOut](#)

getNodeType()

public int getNodeType()

Obtain the node type of the node.

Returns:

an int indicating the node type.

Throws:

[org.iso.mpeg.mpegj.scene.InvalidNodeException](#) - Thrown if the node is no longer valid.

See Also:

[org.iso.mpeg.mpegj.scene.NodeType](#)

removeEventOutListener(int, EventOutListener)

public void removeEventOutListener(int, [org.iso.mpeg.mpegj.scene.EventOutListener](#))

Remove a listener previously added for an eventOut or exposedField in this node of the scene graph.

Parameters:

outID - The outID of the field no longer to be monitored.

listener - The listener that is to be removed.

Throws:

[org.iso.mpeg.mpegj.scene.BadParameterException](#) - Thrown if the selected field ID is not valid for this node.

[org.iso.mpeg.mpegj.scene.InvalidNodeException](#) - Thrown if the node is no longer valid (due to removal or replacement).

See Also:

[org.iso.mpeg.mpegj.scene.EventOut](#), [org.iso.mpeg.mpegj.scene.EventOutListener](#)

sendEventIn(int, FieldValue)

public void sendEventIn(int, [org.iso.mpeg.mpegj.scene.FieldValue](#))

Updates the value of an eventIn or exposedField in this node of the scene graph. This is a synchronous call that will not return until the field is updated in the scene.

Parameters:

`inID` - The inID of the field to be updated.

`newValue` - The desired new value for the field.

Throws:

`org.iso.mpeg.mpegj.scene.BadParameterException` - Thrown if the selected field ID is not valid for this node, or if the value is not an appropriate type for the field.

`org.iso.mpeg.mpegj.scene.InvalidNodeException` - Thrown if the node is no longer valid (due to removal or replacement).

See Also:

[org.iso.mpeg.mpegj.scene.EventIn](#)

V.5.320 org.iso.mpeg.mpegj.scene.NodeType**V.5.320.1 Syntax**

```
public interface NodeType
```

V.5.320.2 Description

An interface defining constants for node types.

| Member Summary | |
|----------------|---|
| Fields | |
| int | Anchor |
| int | AnimationStream |
| int | Appearance |
| int | AudioBuffer |
| int | AudioClip |
| int | AudioDelay |
| int | AudioFX |
| int | AudioMix |
| int | AudioSource |
| int | AudioSwitch |
| int | Background |
| int | Background2D |
| int | Billboard |
| int | Bitmap |
| int | Box |
| int | Circle |
| int | Collision |
| int | Color |
| int | ColorInterpolator |
| int | CompositeTexture2D |
| int | CompositeTexture3D |
| int | Conditional |
| int | Cone |
| int | Coordinate |
| int | Coordinate2D |
| int | CoordinateInterpolator |
| int | CoordinateInterpolator2D |
| int | Curve2D |
| int | Cylinder |
| int | CylinderSensor |
| int | DirectionalLight |
| int | DiscSensor |
| int | ElevationGrid |
| int | Expression |
| int | Extrusion |
| int | Face |
| int | FaceDefMesh |
| int | FaceDefTables |
| int | FaceDefTransform |
| int | FAP |
| int | FDP |

| | |
|-----|--------------------------------|
| int | <u>FIT</u> |
| int | <u>Fog</u> |
| int | <u>FontStyle</u> |
| int | <u>Form</u> |
| int | <u>Group</u> |
| int | <u>ImageTexture</u> |
| int | <u>IndexedFaceSet</u> |
| int | <u>IndexedFaceSet2D</u> |
| int | <u>IndexedLineSet</u> |
| int | <u>IndexedLineSet2D</u> |
| int | <u>Inline</u> |
| int | <u>LOD</u> |
| int | <u>Layer2D</u> |
| int | <u>Layer3D</u> |
| int | <u>Layout</u> |
| int | <u>LineProperties</u> |
| int | <u>ListeningPoint</u> |
| int | <u>Material</u> |
| int | <u>Material2D</u> |
| int | <u>MovieTexture</u> |
| int | <u>NavigationInfo</u> |
| int | <u>Normal</u> |
| int | <u>NormalInterpolator</u> |
| int | <u>OrderedGroup</u> |
| int | <u>OrientationInterpolator</u> |
| int | <u>PixelTexture</u> |
| int | <u>PlaneSensor</u> |
| int | <u>PlaneSensor2D</u> |
| int | <u>PointLight</u> |
| int | <u>PointSet</u> |
| int | <u>PointSet2D</u> |
| int | <u>PositionInterpolator</u> |
| int | <u>PositionInterpolator2D</u> |
| int | <u>ProximitySensor2D</u> |
| int | <u>ProximitySensor</u> |
| int | <u>QuantizationParameter</u> |
| int | <u>Rectangle</u> |
| int | <u>ScalarInterpolator</u> |
| int | <u>Script</u> |
| int | <u>Shape</u> |
| int | <u>Sound</u> |
| int | <u>Sound2D</u> |
| int | <u>Sphere</u> |
| int | <u>SphereSensor</u> |
| int | <u>SpotLight</u> |
| int | <u>Switch</u> |
| int | <u>TermCap</u> |
| int | <u>Text</u> |
| int | <u>TextureCoordinate</u> |
| int | <u>TextureTransform</u> |
| int | <u>TimeSensor</u> |
| int | <u>TouchSensor</u> |
| int | <u>Transform</u> |
| int | <u>Transform2D</u> |
| int | <u>Valuator</u> |
| int | <u>Viewpoint</u> |
| int | <u>VisibilitySensor</u> |
| int | <u>Viseme</u> |
| int | <u>WorldInfo</u> |

V.5.320.3Fields

Anchor

public static final int Anchor

Anchor node = 1.

AnimationStream

public static final int AnimationStream

AnimationStream node = 2.

Appearance

```
public static final int Appearance  
Appearance node = 3.
```

AudioBuffer

```
public static final int AudioBuffer  
AudioBuffer node = 4.
```

AudioClip

```
public static final int AudioClip  
AudioClip node = 5.
```

AudioDelay

```
public static final int AudioDelay  
AudioDelay node = 6.
```

AudioFX

```
public static final int AudioFX  
AudioFX node = 7.
```

AudioMix

```
public static final int AudioMix  
AudioMix node = 8 .
```

AudioSource

```
public static final int AudioSource  
AudioSource node = 9 .
```

AudioSwitch

```
public static final int AudioSwitch  
AudioSwitch node = 10.
```

Background

```
public static final int Background  
Background node = 11.
```

Background2D

```
public static final int Background2D  
Background2D node = 12.
```

Billboard

```
public static final int Billboard  
Billboard node = 13.
```

Bitmap

```
public static final int Bitmap  
Bitmap node = 14.
```

Box

```
public static final int Box  
Box node = 15.
```

Circle

```
public static final int Circle  
Circle node = 16.
```

Collision

```
public static final int Collision  
Collision node = 17.
```

Color

```
public static final int Color  
Color node = 18.
```

ColorInterpolator

```
public static final int ColorInterpolator  
ColorInterpolator node = 19.
```

CompositeTexture2D

```
public static final int CompositeTexture2D
CompositeTexture2D node = 20.
```

CompositeTexture3D

```
public static final int CompositeTexture3D
CompositeTexture3D node = 21.
```

Conditional

```
public static final int Conditional
Conditional node = 22.
```

Cone

```
public static final int Cone
Cone node = 23.
```

Coordinate

```
public static final int Coordinate
Coordinate node = 24.
```

Coordinate2D

```
public static final int Coordinate2D
Coordinate2D node = 25.
```

CoordinateInterpolator

```
public static final int CoordinateInterpolator
CoordinateInterpolator node = 26.
```

CoordinateInterpolator2D

```
public static final int CoordinateInterpolator2D
CoordinateInterpolator2D node = 27.
```

Curve2D

```
public static final int Curve2D
Curve2D node = 28.
```

Cylinder

```
public static final int Cylinder
Cylinder node = 29.
```

CylinderSensor

```
public static final int CylinderSensor
CylinderSensor node = 30.
```

DirectionalLight

```
public static final int DirectionalLight
DirectionalLight node = 31.
```

DiscSensor

```
public static final int DiscSensor
DiscSensor node = 32.
```

ElevationGrid

```
public static final int ElevationGrid
ElevationGrid node = 33.
```

Expression

```
public static final int Expression
Expression node = 34.
```

Extrusion

```
public static final int Extrusion
Extrusion node = 35.
```

Face

```
public static final int Face
Face node = 36.
```

FaceDefMesh

```
public static final int FaceDefMesh  
FaceDefMesh node = 37.
```

FaceDefTables

```
public static final int FaceDefTables  
FaceDefTables node = 38.
```

FaceDefTransform

```
public static final int FaceDefTransform  
FaceDefTransform node = 39.
```

FAP

```
public static final int FAP  
FAP node = 40.
```

FDP

```
public static final int FDP  
FDP node = 41.
```

FIT

```
public static final int FIT  
FIT node = 42.
```

Fog

```
public static final int Fog  
Fog node = 43.
```

FontStyle

```
public static final int FontStyle  
FontStyle node = 44.
```

Form

```
public static final int Form  
Form node = 45.
```

Group

```
public static final int Group  
Group node = 46.
```

ImageTexture

```
public static final int ImageTexture  
ImageTexture node = 47.
```

IndexedFaceSet

```
public static final int IndexedFaceSet  
IndexedFaceSet node = 48.
```

IndexedFaceSet2D

```
public static final int IndexedFaceSet2D  
IndexedFaceSet2D node = 49.
```

IndexedLineSet

```
public static final int IndexedLineSet  
IndexedLineSet node = 50.
```

IndexedLineSet2D

```
public static final int IndexedLineSet2D  
IndexedLineSet2D node = 51.
```

Inline

```
public static final int Inline  
Inline node = 52.
```

Layer2D

```
public static final int Layer2D  
Layer2D node = 54.
```

Layer3D
 public static final int Layer3D
 Layer3D node = 55.

Layout
 public static final int Layout
 Layout node = 56.

LineProperties
 public static final int LineProperties
 LineProperties node = 57.

ListeningPoint
 public static final int ListeningPoint
 ListeningPoint node = 58.

LOD
 public static final int LOD
 LOD node = 53.

Material
 public static final int Material
 Material node = 59.

Material2D
 public static final int Material2D
 Material2D node = 60.

MovieTexture
 public static final int MovieTexture
 MovieTexture node = 61.

NavigationInfo
 public static final int NavigationInfo
 NavigationInfo node = 62.

Normal
 public static final int Normal
 Normal node = 63.

NormalInterpolator
 public static final int NormalInterpolator
 NormalInterpolator node = 64.

OrderedGroup
 public static final int OrderedGroup
 OrderedGroup node = 65.

OrientationInterpolator
 public static final int OrientationInterpolator
 OrientationInterpolator node = 66.

PixelTexture
 public static final int PixelTexture
 PixelTexture node = 67.

PlaneSensor
 public static final int PlaneSensor
 PlaneSensor node = 68.

PlaneSensor2D
 public static final int PlaneSensor2D
 PlaneSensor2D node = 69.

PointLight
 public static final int PointLight
 PointLight node = 70.

PointSet

public static final int PointSet

PointSet node = 71.

PointSet2D

public static final int PointSet2D

PointSet2D node = 72.

PositionInterpolator

public static final int PositionInterpolator

PositionInterpolator node = 73.

PositionInterpolator2D

public static final int PositionInterpolator2D

PositionInterpolator2D node = 74.

ProximitySensor

public static final int ProximitySensor

ProximitySensor node = 76.

ProximitySensor2D

public static final int ProximitySensor2D

ProximitySensor2D node = 75.

QuantizationParameter

public static final int QuantizationParameter

QuantizationParameter node = 77.

Rectangle

public static final int Rectangle

Rectangle node = 78.

ScalarInterpolator

public static final int ScalarInterpolator

ScalarInterpolator node = 79.

Script

public static final int Script

Script node = 80.

Shape

public static final int Shape

Shape node = 81.

Sound

public static final int Sound

Sound node = 82.

Sound2D

public static final int Sound2D

Sound2D node = 83.

Sphere

public static final int Sphere

Sphere node = 84.

SphereSensor

public static final int SphereSensor

SphereSensor node = 85.

SpotLight

public static final int SpotLight

SpotLight node = 86.

Switch

public static final int Switch

Switch node = 87.

TermCap

```
public static final int TermCap
```

TermCap node = 88.

Text

```
public static final int Text
```

Text node = 89.

TextureCoordinate

```
public static final int TextureCoordinate
```

TextureCoordinate node = 90.

TextureTransform

```
public static final int TextureTransform
```

TextureTransform node = 91.

TimeSensor

```
public static final int TimeSensor
```

TimeSensor node = 92.

TouchSensor

```
public static final int TouchSensor
```

TouchSensor node = 93.

Transform

```
public static final int Transform
```

Transform node = 94.

Transform2D

```
public static final int Transform2D
```

Transform2D node = 95.

Valuator

```
public static final int Valuator
```

Valuator node = 96.

Viewpoint

```
public static final int Viewpoint
```

Viewpoint node = 97.

Viseme

```
public static final int Viseme
```

Viseme node = 99.

VisibilitySensor

```
public static final int VisibilitySensor
```

VisibilitySensor node = 98.

WorldInfo

```
public static final int WorldInfo
```

WorldInfo node = 100.

V.5.321 org.iso.mpeg.mpegj.scene.NodeValue**V.5.321.1 Syntax**

```
public interface NodeValue
```

All Known Subinterfaces:

[org.iso.mpeg.mpegj.scene.NewNode](#)

V.5.321.2 Description

An interface for node values that either act as a proxy for a node in the BIFS scene, or specify the creation of a new node.

V.5.322 org.iso.mpeg.mpegj.scene.Scene**V.5.322.1 Syntax**

```
public interface Scene
```

V.5.322.2 Description

An interface that acts as a proxy for a BIFS scene.

| Member Summary | |
|-----------------------|------------------------------|
| Methods | |
| Node | getNode(int) |

V.5.322.3 Methods**getNode(int)**

```
public org.iso.mpeg.mpegj.scene.Node getNode(int)
```

Returns an instance of a Node proxy for an instanced node in the scene.

Parameters:

defID - The id of the desired node. This node must have been instanced using DEF.

Returns:

a Node proxy for the desired node in the scene.

Throws:

[org.iso.mpeg.mpegj.scene.BadParameterException](#) - Thrown if no node exists with the specified id.

[org.iso.mpeg.mpegj.scene.InvalidSceneException](#) - Thrown if the Scene is no longer valid (due to removal or replacement).

V.5.323 org.iso.mpeg.mpegj.scene.SceneListener**V.5.323.1 Syntax**

```
public interface SceneListener
```

V.5.323.2 Description

An interface that allows monitoring of changes to a BIFS scene graph.

| Member Summary | |
|-----------------------|---------------------------------------|
| Inner Classes | |
| Methods | |
| static interface | SceneListener.Message |
| void | notify(int, Scene) |

V.5.323.3 Methods**notify(int, Scene)**

```
public void notify(int, org.iso.mpeg.mpegj.scene.Scene)
```

Called by the scene manager when the BIFS scene has been changed.

Parameters:

whatHappened - contains the message number that indicates the change.

newScene - contains the new Scene object when appropriate.

V.5.324 org.iso.mpeg.mpegj.scene.SceneListener.Message**V.5.324.1 Syntax**

```
public static interface SceneListener.Message
```

V.5.324.2Description

The message numbers used in the notify method.

| Member Summary | |
|-----------------------|-----------------------|
| Fields | |
| int | <u>SCENE_READY</u> |
| int | <u>SCENE_REPLACED</u> |
| int | <u>SCENE_REMOVED</u> |

V.5.324.3Fields

SCENE_READY

public static final int SCENE_READY

When the listener is first added this message is sent with the current valid Scene instance. SCENE_READY = 1;

SCENE_REMOVED

public static final int SCENE_REMOVED

Indicates that the scene has been removed. SCENE_REMOVED = 3;

SCENE_REPLACED

public static final int SCENE_REPLACED

Indicates that the scene has been replaced. SCENE_REPLACED = 2;

V.5.325 org.iso.mpeg.mpegj.scene.SceneManager

V.5.325.1 Syntax

```
public interface SceneManager
```

V.5.325.2Description

An interface that allows access to the MPEG-4 terminal's native scene. An instance is obtained using getSceneManager() in the MPEGJTerminal class.

Note that scene graph access requires first obtaining a Scene instance. The only normative way to get a Scene instance is through a notification on a SceneListener instance.

See Also:

[org.iso.mpeg.mpegj.MpegjTerminal](#),
[org.iso.mpeg.mpegj.scene.Scene](#)

[org.iso.mpeg.mpegj.scene.SceneListener](#),

| Member Summary | |
|-----------------------|---|
| Methods | |
| void | <u>addSceneListener(SceneListener)</u> |
| void | <u>removeSceneListener(SceneListener)</u> |

V.5.325.3Methods

addSceneListener(SceneListener)

public void addSceneListener([org.iso.mpeg.mpegj.scene.SceneListener](#))

Add a SceneListener to this scene manager. The listener will be informed of important changes to the scene, and will be given the appropriate Scene instance that will allow modification to nodes and fields of the scene. The base specification does not limit the number of SceneListeners that may be registered.

Parameters:

listener - the SceneListener instance to add.

removeSceneListener(SceneListener)

public void removeSceneListener([org.iso.mpeg.mpegj.scene.SceneListener](#))

Remove a SceneListener from the scene manager.

Parameters:

listener - the SceneListener instance to remove.

Throws:

org.iso.mpeg.mpegj.scene.BadParameterException - Thrown if the specified listener was not found on the scene manager's list of listeners.

V.5.326 org.iso.mpeg.mpegj.scene.SFBoolFieldValue**V.5.326.1 Syntax**

```
public interface SFBoolFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

org.iso.mpeg.mpegj.scene.FieldValue

V.5.326.2 Description

An interface used for obtaining SFBool values.

| Member Summary | |
|-----------------------|-------------------------|
| Methods | |
| boolean | <u>getSFBoolValue()</u> |

V.5.326.3 Methods**getSFBoolValue()**

```
public boolean getSFBoolValue()
```

Obtain the SFBool value.

Returns:

a boolean that contains the SFBool value.

V.5.327 org.iso.mpeg.mpegj.scene.SFColorFieldValue**V.5.327.1 Syntax**

```
public interface SFColorFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

org.iso.mpeg.mpegj.scene.FieldValue

V.5.327.2 Description

An interface used for obtaining SFColor values.

| Member Summary | |
|-----------------------|--------------------------|
| Methods | |
| float[] | <u>getSFColorValue()</u> |

V.5.327.3 Methods**getSFColorValue()**

```
public float[] getSFColorValue()
```

Obtain the SFColor value.

Returns:

an array of three floats ordered as red, green, blue.

V.5.328 org.iso.mpeg.mpegj.scene.SFFloatFieldValue**V.5.328.1 Syntax**

```
public interface SFFloatFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

org.iso.mpeg.mpegj.scene.FieldValue

V.5.328.2Description

An interface used for obtaining SFFloat values.

| Member Summary | |
|-----------------------|--|
| Methods | |
| float | <u>getSFFloatValue()</u> |

V.5.328.3Methods

getSFFloatValue()

public float [getSFFloatValue\(\)](#)

Obtain the SFFloat value.

Returns:

a float value of the SFFloat field.

V.5.329 org.iso.mpeg.mpegj.scene.SFInt32FieldValue

V.5.329.1Syntax

```
public interface SFInt32FieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.329.2Description

An interface used for obtaining SFInt32 values.

| Member Summary | |
|-----------------------|--|
| Methods | |
| int | <u>getSFInt32Value()</u> |

V.5.329.3Methods

getSFInt32Value()

public int [getSFInt32Value\(\)](#)

Obtain the SFInt32 value.

Returns:

a int value of the SFInt32 field.

V.5.330 org.iso.mpeg.mpegj.scene.SFNodeFieldValue

V.5.330.1Syntax

```
public interface SFNodeFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.330.2Description

An interface used for obtaining SFNode values.

| Member Summary | |
|-----------------------|---|
| Methods | |
| NodeValue | <u>getSFNodeValue()</u> |

V.5.330.3Methods

getSFNodeValue()

public [org.iso.mpeg.mpegj.scene.NodeValue](#) [getSFNodeValue\(\)](#)

ISO/IEC 14496-1:2001(E)

Obtain the SFNode value. If this object was obtained by the getEventOut method of the Node interface, then the return value shall contain a proxy for a node in the BIFS scene. If this object has been passed to the sendEventIn method of the Node interface, then the return value shall contain either a proxy or an object implementing the NewNode interface to specify how to create a new node.

Returns:

a NodeValue object either acting as a proxy for a node in the BIFS scene or specifying how to create a new node.

V.5.331 org.iso.mpeg.mpegj.scene.SFRotationFieldValue

V.5.331.1 Syntax

```
public interface SFRotationFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.331.2 Description

An interface used for obtaining SFRotation values.

| Member Summary | |
|----------------|--------------------------------------|
| Methods | |
| float[] | getSFRotationValue() |

V.5.331.3 Methods

getSFRotationValue()

```
public float[] getSFRotationValue()
```

Obtain the SFRotation value.

Returns:

a float array ordered as (x,y,z,angle) with VRML-97 semantics.

V.5.332 org.iso.mpeg.mpegj.scene.SFStringFieldValue

V.5.332.1 Syntax

```
public interface SFStringFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.332.2 Description

An interface used for obtaining SFString values.

| Member Summary | |
|----------------|------------------------------------|
| Methods | |
| String | getSFStringValue() |

V.5.332.3 Methods

getSFStringValue()

```
public java.lang.String getSFStringValue()
```

Obtain the SFString value.

Returns:

a String value of the SFString field.

V.5.333 org.iso.mpeg.mpegj.scene.SFTimeFieldValue**V.5.333.1 Syntax**

```
public interface SFTimeFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.333.2 Description

An interface used for obtaining SFTime values.

| Member Summary | |
|-----------------------|---|
| Methods | double getSFTimeValue() |

V.5.333.3 Methods**getSFTimeValue()**

```
public double getSFTimeValue()
```

Obtain the SFTime value.

Returns:

a double value of the SFTime field.

V.5.334 org.iso.mpeg.mpegj.scene.SFVec2fFieldValue**V.5.334.1 Syntax**

```
public interface SFVec2fFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.334.2 Description

An interface used for obtaining SFVec2f values.

| Member Summary | |
|-----------------------|---|
| Methods | float[] getSFVec2fValue() |

V.5.334.3 Methods**getSFVec2fValue()**

```
public float[] getSFVec2fValue()
```

Obtain the SFVec2f value.

Returns:

a float array containing the value of the SFVec2f field.

V.5.335 org.iso.mpeg.mpegj.scene.SFVec3fFieldValue**V.5.335.1 Syntax**

```
public interface SFVec3fFieldValue extends org.iso.mpeg.mpegj.scene.FieldValue
```

All Superinterfaces:

[org.iso.mpeg.mpegj.scene.FieldValue](#)

V.5.335.2 Description

An interface used for obtaining SFVec3f values.

| Member Summary | |
|----------------|--|
| Methods | |
| float[] | <u>getSFVec3fValue()</u> |

V.5.335.3 Methods

[getSFVec3fValue\(\)](#)

V.5.336 public float[] getSFVec3fValue()

Obtain the SFVec3f value.

Returns:

a float array containing the value of the SFVec3f field.

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