INTERNATIONAL STANDARD

**ISO/IEC 14496-16**

Second edition
2006-12-15

**AMENDMENT 3**
2008-09-15

# Information technology — Coding of audio-visual objects

## Part 16: Animation Framework eXtension (AFX)

## AMENDMENT 3: 3D Multiresolution profile

*Technologies de l'information — Codage des objets audiovisuels*

*Partie 16: Extension du cadre d'animation (AFX)*

*AMENDEMENT 3: Profil multirésolution en 3D*

Reference number
ISO/IEC 14496-16:2006/Amd.3:2008(E)

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Amendment 3 to ISO/IEC 14496-16:2006 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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# Information technology — Coding of audio-visual objects

## Part 16:
## Animation Framework eXtension (AFX)

## AMENDMENT 3: 3D Multiresolution profile

*After 7.2.1, add the following new subclause:*

### 7.2.2 MPEG-4 Basic AFX Graphics Profiles and Levels

#### 7.2.2.1 List of tools/functionalities

The Basic AFX Graphics Profile represents a collection of nodes to allow progressive and adaptive transmission over networks of large 3D environments and / or complexe 3D shapes. It includes the following nodes : Appearance, Background, Color, Coordinate, DirectionalLight, ElevationGrid, IndexedFaceSet, IndexedLineSet, Material, PointLight, Shape, SpotLight, TextureCoordinate, TextureTransform, ProceduralTexture (V.5), SBVCAnimation, SBVCSkinnedModel, SBBone, SBSegment, SubdivisionSurfaces, WaveletSubdivisionSurfaces and FootPrint.

#### 7.2.2.2 Comparison with existing profiles

The Basic AFX Scene Graph profile represents a collection of nodes to allow progressive and adaptive transmission over networks of large 3D environments and / or complexe 3D shapes

The existing ‘X3D’ profile does not provide compression tools.

#### 7.2.2.3 Basic AFX Graphics Profile @ Level 1 and 2 Definition

In Table AMD3.1, definitions for level 1 of the 3D Multiresolution Graphics profile are given.

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**Table AMD3.1 – Level 1 & 2 of Basic AFX Graphics profile**

| Node | Maximum values for content related parameters | |
|---|---|---|
| | **Level 1** | **Level 2** |
| Appearance | Ignore *TextureTransform.* | Full features supported. |
| Color | $2^{16}$ colors* | $2^{32}$ colors* |
| Coordinate | $2^{16}$ points* | $2^{32}$ points* |
| DirectionalLight | Not scoped by parent *Group* or *Transform*. | Scoped by parent *Group* or *Transform*. |
| IndexedFaceSet | Only triangle face supported.<br>A given *coordIndex* is not repeated in a face.<br>Ignore *set_colorIndex.*<br>Ignore *set_normalIndex.* | Full features supported. |
| IndexedLineSet | Ignore *set_colorIndex.*<br>Ignore *set_coordIndex.* | Full features supported. |
| Material | Ignore *AmbientIntensity.*<br>Ignore *Shininess*.<br>Ignore *SpecularColor.* | Full features supported. |
| PointLight | Ignore *radius.*<br>Ignore Linear attenuation. | Full features supported. |
| Shape | Full features support. | Full features supported. |
| SpotLight | Ignore *beamWidth.*<br>Ignore *radius.*<br>Ignore Linear attenuation. | Full features supported. |
| TextureCoordinate | $2^{16}$ coordinates* | $2^{32}$ coordinates* |
| WaveletSubdivision Surfaces | 12 bitplanes per coordinate<br>4 levels of subdivision | 24 bitplanes per coordinates<br>10 levels of subdivision |
| FootPrint | Full features supported. | Full features supported. |

* indicates maximum vector size.


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Table AMD3.2 specifies further restriction to the fields of the nodes listed in Table AMD3.1. These Tables can be used for both the Profile and the Level definitions.

**Table AMD3.2 – Functionality limitation and minimum system requirement**

| Node | Restrictions (Maximum values) |
|---|---|
| All lights | 8 simultaneous lights. |
| Names for DEF/field | 50 utf8 octets. |
| All *url* fields | 10 URLs. URN's ignored.<br>Support relative URLs where relevant. |
| SFBool | Full support. |
| SFColor | Full support. |
| SFFloat | Full support. |
| SFImage | 256 width. 256 height. |
| SFInt32 | Full support. |
| SFNode | Full support. |
| SFRotation | Full support. |
| SFString | 30,000 utf8 octets. |
| SFTime | Full support. |
| SFVec2f | 15,000 values. |
| SFVec3d | 15,000 values. |
| SFVec3f | 15,000 values. |
| MFColor | 15,000 values. |
| MFFloat | 1,000 values. |
| MFInt32 | 20,000 values. |
| MFNode | 500 values. |
| MFRotation | 1,000 values. |
| MFString | 30,000 utf8 octets per string, 10 strings. |
| MFVec2f | 15,000 values. |
| MFVec3d | 15,000 values. |
| MFVec3f | 15,000 values. |

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*Add the following new subclause after 7.3.1:*

### 7.3.2 MPEG-4 Basic AFX Scene Graph Profile and Levels

#### 7.3.2.1 List of tools/functionalities

The Basic AFX Scene Graph profile represents a collection of nodes to allow progressive and adaptive transmission over networks of large 3D environments and / or complexe 3D shapes. It contains the same set of nodes as the X3D Scene Graph Profile, plus the Bitwrapper node.

#### 7.3.2.2 Comparison with existing profiles

The Basic AFX Scene Graph profile represents a collection of nodes to allow progressive and adaptive transmission over networks of large 3D environments and / or complexe 3D shapes

The existing 'X3D' profile does not provide compression tools.

#### 7.3.2.3 Basic AFX Scene Graph Profile @ Level 1 Definition

In Table AMD3.3, definitions for level 1 of the Basic AFX Scene Graph profile are given.

**Table AMD3.3 – Level 1 of Basic AFX Scene Graph profile**

| Node | Maximum values for content related parameters | |
|---|---|---|
| | **Level 1** | **Level 2** |
| CoordinateInterpolator | Full features supported. | Full features supported. |
| Group | Ignore *AddChildren*,<br>Ignore *removeChildren* | Full features supported. |
| NavigationInfo | Ignore *AvatarSize,*<br>Ignore *speed,*<br>Ignore *type,*<br>Ignore *visibilityLimit* | Full features supported. |
| OrientationInterpolator | Full features supported. | Full features supported. |
| PositionInterpolator | Full features supported. | Full features supported. |
| ScalarInterpolator | Full features supported. | Full features supported. |
| TouchSensor | Full features supported. | Full features supported. |
| Transform | Ignore *AddChildren*,<br>Ignore *removeChildren* | Full features supported. |


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| | | |
|---|---|---|
| Viewpoint | Ignore *FieldOfView,*<br>Ignore *description* | Full features supported. |
| WorldInfo | Full features supported. | Full features supported. |
| QuantizationParameter | Full features supported. | Full features supported. |
| Scene Updates | Full features supported. | Full features supported. |
| ROUTE | Full features supported. | Full features supported. |

Table AMD3.4 specifies other aspects of functionality that are supported by this profile. Note that general items refer only to those specific nodes listed in Table AMD3.3.

**Table AMD3.4 – Functionality Limitations and Minimum System Requirements**

| Node | Minimum System Support |
|---|---|
| All groups | 500 children. Ignore *bboxCenter* and *bboxSize*. |
| All interpolators | 1000 key-value pairs. |
| Names for DEF/field | 50 utf8 octets. |
| All *url* fields | 10 URLs. URN's ignored.<br>Support relative URLs where relevant. |
| SFBool | Full support. |
| SFFloat | Full support. |
| SFImage | 256 width. 256 height. |
| SFInt32 | Full support. |
| SFNode | Full support. |
| SFRotation | Full support. |
| SFString | 30,000 utf8 octets. |
| SFTime | Full support. |
| SFVec2f | 15,000 values. |
| SFVec3d | 15,000 values. |
| SFVec3f | 15,000 values. |
| MFFloat | 1,000 values. |
| MFInt32 | 20,000 values. |
| MFNode | 500 values. |

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| | |
|---|---|
| MFRotation | 1,000 values. |
| MFString | 30,000 utf8 octets per string, 10 strings. |
| MFVec2f | 15,000 values. |
| MFVec3d | 15,000 values. |
| MFVec3f | 15,000 values. |

*In 7.4 replace:*

**Table 33 — 3DCompressionProfileLevelIndication Values.**

| Value | Profile | Level |
|---|---|---|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Core | L1 |
| 0x02 | Core | L2 |
| 0x0A-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no 3D Compression profile specified | - |
| 0xFF | no 3D Compression capability required | - |
| Note: Usage of the value 0xFE may indicate that the content described by this descriptor does not comply with any conformance point specified in this international standard. | | |

*with:*

**Table 33 — 3DCompressionProfileLevelIndication Values.**

| Value | Profile | Level |
|---|---|---|
| 0x00 | Reserved for ISO use | - |
| 0x01 | Core | L1 |
| 0x02 | Core | L2 |
| 0X03 | 3D Multiresolution | L1 |
| 0X04 | 3D Multiresolution | L2 |
| 0x0A-0x7F | reserved for ISO use | - |
| 0x80-0xFD | user private | - |
| 0xFE | no 3D Compression profile specified | - |
| 0xFF | no 3D Compression capability required | - |
| Note: Usage of the value 0xFE may indicate that the content described by this descriptor does not comply to any conformance point specified in this international standard. | | |

*Add the following new subclause after 7.4.1:*

### 7.4.2 3D Multiresolution Compression Profile and Levels

#### 7.4.2.1 List of Tools/Functionalities

The 3D Multiresolution Compression profile combines the 3D Mesh Compression, Interpolation Compression, Wavelet Subdivision Surface, and Bone Based Animation tools for efficient 3D resource transmission and storage.

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#### 7.4.2.2 List of Tools/Functionalities

The "3D Multiresolution Compression" profile represents a collection of compression tools to allow implementation of minimum functionalities for compact transmission and storage of 3D object under a constrained environment (e.g. mobile), where the processing power and memory size can be very limited.

The "Multiresolution Compression" profile contains the following 3D Compression object types:

- The **Simple 3DMC** object type provides high compression and error resilience for static triangle 3D models.
- The **Simple CI** object type compresses the Coordinate Interpolator animation.
- The **Simple PI** object type compresses the Position Interpolator animation. It can support both Key-Preserving and Path-Preserving mode.
- The **Simple OI** object type compresses the Orientation Interpolator animation. It can support both Key-Preserving and Path-Preserving mode.
- The **Main WSS** object type represents, in a compressed form, the details for subdivision of 3D mesh. This tool is used for level of detail management and animation.
- The **Simple FootPrint** object type represents in a compressed form the multiresolution of 2D and a half data.
- The **Simple BBA** object type compresses the skeleton animation based on bone transforms and connected to a skin mesh model. This object type does not support Muscle.

**Table AMD3.5 – 3D Compression Object Types**

| AFX Tools | 3D Compression Object Types | | | | | | |
|---|---|---|---|---|---|---|---|
| | Simple 3DMC | Simple CI | Simple PI | Simple OI | Main WSS | Simple BBA | Simple Footprint |
| 3D Mesh Compression (3DMC)<br>• Basic | X | | | | | | |
| CoordinateInterpolator (CI) | | X | | | | | |
| PositionInterpolator (PI)<br>• Key Preserving<br>• Path Preserving | | | X | | | | |
| OrientationInterpolator (OI)<br>• Key Preserving<br>• Path Preserving | | | | X | | | |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Wavelet Subdivision Surface (WSS)<br>• IndexedFace Set or 3DMC for base mesh<br>• Backchannel enabled | | | | | X | | |
| BBA<br>• Only Bones | | | | | | X | |
| Footprint-based Coding<br>• Bckchannel enabled | | | | | | | X |

The "3D Multiresolution Compression" includes the object types as illustrated in Table AMD3.6.

**Table AMD3.6 – "3D Multiresolution Compression" Profile**

| | "3D Compression" Object Types | | | | | | |
|---|---|---|---|---|---|---|---|
| | Simple 3DMC | Simple CI | Simple PI | Simple OI | Main WSS | Simple BBA | Simple Footprint |
| 3D Multiresolution Compression Profile | X | X | X | X | X | X | X |

#### 7.4.2.3 Comparison with Existing Profiles and object types

The existing 'Core 3D Profile' is targeted for mobile applications and contains much simpler tools.

#### 7.4.2.4 Profile Level Definition

According to target device and applications, two levels are defined as listed in Tables AMD3.7, AMD3.8, and AMD3.9. Level 1 is for mobile devices, while the level 2 is targeted at workstations or dedicated hardware.


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**Table AMD3.7 – Levels and data constraints.**

| Level | Data Constraints |
|---|---|
| Level 1 | General:<br>• Number of triangles in a scene ≤ 5000<br>• Number of objects in a scene ≤ 100<br>• 16.16 FixedPoint, 8-bit and 16-bit Integer<br>BBA:<br>• Number of bones attachable to an object ≤ 30<br>• Number of bones affecting a vertex ≤ 4<br>WSS:<br>• Number of triangles in the base mesh ≤ 500<br>• Number of bitplanes ≤ 10<br>• Number of levels of details ≤ 4<br>Footprint:<br>• Number of buildings ≤ 500<br>• Tree depth ≤ 4 |
| Level 2 | General:<br>• Arbitrary number of triangles in a scene<br>• Arbitrary number of objects in a scene<br>BBA:<br>• Number of bones attachable to an object ≤ 300<br>• Number of bones affecting a vertex ≤ 10 |

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**Table AMD3.8 – Levels and functionalities constraints.**

| Level | Functionality Constraints |
|---|---|
| Level 1 | General<br>• Triangle only<br>• Full support of *colorIndex, normalIndex, texcoordIndex*<br>• The vertices of a face shall not define a self-intersecting polygon<br>• A given *coordIndex* is not repeated in a face<br>• *Color* and *Texture* can be blended.<br>Footprint and WSS:<br>• *"Back Channel*" not supported |
| Level 2 | General:<br>• Full support of *colorIndex, normalIndex, texcoordIndex*<br>• The vertices of a face shall not define a self-intersecting polygon<br>• A given *coordIndex* is not repeated in a face<br>• *Color* and *Texture* can be blended.<br>Footprint and WSS:<br>• *"Back Channel*" supported |


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**Table AMD3.9 – Levels and player constraints.**

| Level | Player Constraints (Informative Recommendation) |
|---|---|
| Level 1 | General:<br>• Size of Texture memory ≤ 4 M<br>• Number of light ≤ 8<br>• Directional Light, PointLight and SpotLight<br>• Material: ambientIntensity, diffuseColor, emissiveColor, shininess, specularColor<br>• Transparency<br>• Flat and Gouraud shading<br>• Texture Blending<br>• Texture Filtration<br>• Perspective correction<br>• Total Decoding Time ≤ 10sec |
| Level 2 | General:<br>• Unlimited size of texture memory<br>• Arbitrary number of lights<br>• Directional Light, PointLight and SpotLight<br>• Material: ambientIntensity, diffuseColor, emissiveColor, shininess, specularColor<br>• Transparency<br>• Flat and Gouraud shading<br>• Texture Blending<br>• Texture Filtration<br>• Perspective correction |

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