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Information technology — Coding of audio-visual objects —

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

AMENDMENT 3: Printing material and 3D graphics coding for browsers

Technologies de l'information — Codage des objets audiovisuels —

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

AMENDEMENT 3: Représentation efficiente de maillages 3D à multiples attributs

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Foreword

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Amendment 3 to ISO/IEC 14496-16:2011 was prepared by 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 16: Animation Framework eXtension (AFX)

AMENDMENT 3: Printing material and 3D graphics coding for browsers

Page 48, 4.3.6.4.2

Replace the following:

```
IndexedRegionSet {
  coord Coordinate {point [
    0 0 0, 1 0 0, 1 1 0, 0 1 0, 0 1 1, 0 0 1, 1 0 1, 1 1 1, 0.5 0.5 0
  ]}
  texCoord TextureCoordinate {point [
    0 0, 0.333 0, 0.667 0, 1 0, 0 1, 0.333 1, 0.667 1, 1 1, 0.667 0.5
  ]}
  region [
    Region {
      coordIndex [
        2 1 8 -1, 1 0 8 -1, 0 3 8 -1, 3 2 8 -1, 1 2 7 -1, 7 6 1 -1, 5 6 7 -1, 7 4 5 -1
      ]
      texCoordIndex [5 1 0 4 7 6 2 3 8]
      texture ImageTexture {url "../pix/136.png"}
    }
    Region {
      coordIndex [4 3 0 -1, 0 5 4 -1, 6 5 0 -1, 0 1 6 -1, 3 4 7 -1, 7 2 3 -1]
      texCoordIndex [4 7 6 5 1 0 3 2]
      texture ImageTexture {url "../pix/245.png"}
    }
  ]
}
```

With the following:

```
IndexedRegionSet {
[…]
    Region {
      coordIndex [
        2 1 8 -1, 1 0 8 -1, 0 3 8 -1, 3 2 8 -1, 6 5 0 -1, 0 1 6 -1, 5 6 7 -1, 7 4 5 -1
      ]
[…]
    }
    Region {
      coordIndex [4 3 0 -1, 0 5 4 -1, 1 2 7 -1, 7 6 1 -1, 3 4 7 -1, 7 2 3 -1]
[…]
    }
}
```

Page 48, 4.3.7

Replace the current 4.3.7 (which shall be renumberred to 4.3.8) with the following.

4.3.7 3D meshes with Printing Material Texture

4.3.7.1 General

The **IndexedPrintingRegionSet (IPRS)** node is based on the **IndexedRegionSet** described in 4.3.6 and it describes region-based printing material information which can be used in the 3D printing application. The main design concept of **IPRS** is that the representation shall be easy to the designer. Based on this concept, **IPRS** has adopted texture mapping method for describing the printing material information because it is very popular to the designer. Thanks to the region-based texture mapping, per face or region or global material mapping is possible.

4.3.7.2 IndexedPrintingRegionSet node

4.3.7.2.1 Node interface

```
IndexedPrintingRegionlSet {
    eventIn         MFInt32     set_colorIndex
    eventIn         MFInt32     set_coordIndex
    eventIn         MFInt32     set_normalIndex
    eventIn         MFInt32     set_texCoordIndex
    exposedField    SFString    unit                         #mm, cm, m, inch
    exposedField    SFFloat     minimumVerticalResolution    #unit is unit
    exposedField    SFNode      color                        NULL
    exposedField    SFNode      coord                        NULL
    exposedField    SFNode      normal                       NULL
    exposedField    SFNode      texCoord                     TRUE
    field           SFBool      ccw                          []          #[-1,inf)
    field           MFInt32     colorIndex                   TRUE
    field           SFBool      colorPerVertex               TRUE
    field           SFBool      convex                       []
    field           MFNode      printingRegions              0           #[0,inf)
    field           SFFloat     creaseAngle                  []          #[-1,inf)
    field           MFInt32     normalIndex
    field           SFBool      normalPerVertex              TRUE
    field           SFBool      solid                        TRUE
    field           MFInt32     texCoordIndex                []          #[0,inf)
}
```

4.3.7.2.2 Functionality and semantics

An **IPRS** node has exactly the same fields as an **IRS** one, except for the physical size information of printout, and ***region*** field, which has been replaced by ***printingMaterialRegion***.

4.3.7.3 PrintingRegion node

4.3.7.3.1 Node interface

```
PrintingRegion {
exposedField    MFInt32    printingMaterialType          NULL
exposedField    SFFloat    surfaceThickness              #unit is unit
exposedField    SFNode     color                         NULL
exposedField    SFNode     normal                        NULL
exposedField    SFNode     texCoord                      NULL
exposedField    SFNode     colorTexture                  NULL
exposedField    SFNode     printingMaterialTexture       NULL
exposedField    SFNode     textureTransform              NULL
field           MFInt32    colorIndex                    []      #[-1,inf)
field           MFInt32    coordIndex                    []      #[-1,inf)
field           MFInt32    normalIndex                   []      #[-1,inf)
field           MFInt32    texCoordIndex                 []      #[0,inf)
field           MFInt32    printingMaterialTexCoordIndex []      #[0,inf)
}
```

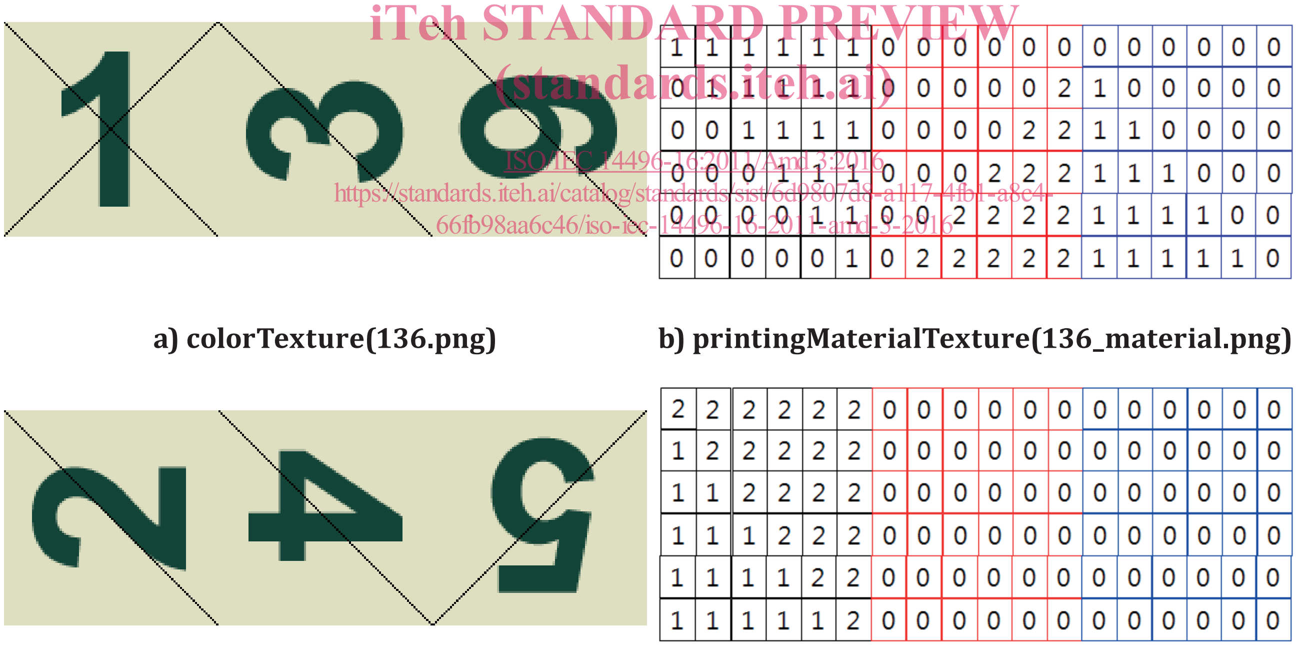
4.3.7.3.2 Functionality and semantics

field name	semantic
unit	It has single string value which shall be one of the length unit defined in the ISO/IEC 23005-6 (UnitTypeCS). It defines the unit of the ***coord*** field. When this value is set as mm, all the ***coord*** values are interpreted as mm (millimetre).
surfaceThickness	It defines the suggested surface thickness of the model. For example, a cylinder model with 5 ***surfaceThickness*** is interpreted as “Print the cylinder with 5 mm surface and leave the inside empty.” Here, the unit for ***surfaceThickness*** is the same as ***unit*** files.
minimumVerticalResolution	It defined the resolution for the acquisition process. When the model is designed based on the scanner, the scanner resolution is mentioned here. When this field is set as 0.1, the 3D printing resolution which is smaller than ***minimumVerticalResolution*** does not make sense. In this way, the printing resolution may be estimated. Here, the unit for ***minimumVerticalResolution*** is the same as ***unit*** files.
printingRegions	It has **PrintingRegion** node which defined the physical material characteristics of print-out. It has multiple nodes. When a single element is provided, the whole model is considered as one region.
printingMaterialType	It has multiple integers that defines the printing materials of print-out as a reference to a classification defined in ISO/IEC 23005-6 (PrintingMaterialCS). When a single material is provided, the whole region is printed as one material.

field name	semantic
colorTexture	It defines the color texture used in each region for rendering purpose.
printingMaterialTexture	It defines the printing material texture map used in each region. It shall be lossless gray image format such as PNG because the lossy compression results in a misunderstanding on the printing material information. And the values in the image are restricted by ***printingMaterialType***. All values in the printing material texture are one value in the ***printingMaterialType*** array. For example, when the ***printingMaterialType*** is provided as [0, 1, 2], the ***printingMaterialTexture*** shall has values among 0, 1, and 2. When the array length of ***printingMaterialType*** is 1, the ***printingMaterialTexture*** is null because this region is printed as a single material with ***printingMaterialType***.
texCoordIndex	It defines the texture coordinate indexes of ***colorTexture***.
printingMaterialTexCoordIndex	It defines the texture coordinate indexes of ***printingMaterialTexture***. When this is null, ***texCoordIndex*** is used as ***printingMaterialTexCoordIndex***.

4.3.7.4 Examples

The following examples are based on the IRS representation described in 4.3.6.4.3. It has two printingRegion and each printingRegion has *colorTexture* and *printignMaterialTexture* as illustrated in Figure 25.



1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	0	0	0	0	0	2	1	0	0	0	0	0
0	0	1	1	1	1	0	0	0	0	2	2	1	1	0	0	0	0
0	0	0	1	1	1	0	0	0	2	2	2	1	1	1	0	0	0
0	0	0	0	1	1	0	0	2	2	2	2	1	1	1	1	0	0
0	0	0	0	0	1	0	2	2	2	2	2	1	1	1	1	1	0

a) colorTexture(136.png)

b) printingMaterialTexture(136_material.png)

2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
1	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
1	1	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0

c) colorTexture(245.png)

d) printingmaterialTexture(245_material.png)

Figure 25 — IPRS example with two printingRegion;

In this example, three materials [0, 1, 2] are used thus the values in the printingMaterialTexture are restricted by 0, 1 and 2.

```
IndexedPrintingRegionSet{
  unit "mm"
  minimumVerticalResolution 0.1
  coord Coordinate {
    point [ 0 0 0, 1 0 0, 1 1 0, 0 1 0, 0 1 1, 0 0 1, 1 0 1, 1 1 1, 0.5 0.5 0 ]
  }
  texCoord TextureCoordinate {
    point [ 0 0, 0.333 0, 0.667 0, 1 0, 0 1, 0.333 1, 0.667 1, 1 1, 0.1667 0.5 ]
  }
  printingRegions [
    PrintingRegion {
       surfaceThickness 10.0
       printingMaterialType [0, 1, 2]
       coordIndex [ 2 1 8 -1, 1 0 8 -1, 0 3 8 -1, 3 2 8 -1, 6 5 0 -1, 0 1 6 -1, 5 6 7 -1,
7 4 5 -1 ]
       texCoordIndex [5 1 0 4 7 6 2 3 8]
       colorTexture            ImageTexture  {  url "../pix/136.png"   }
       printingMaterialTexture ImageTexture  {  url "../material/136_material.png" }
    }
    PrintingRegion {
      surfaceThickness 15.0
      printingMaterialType [0, 1, 2]
      coordIndex [4 3 0 -1, 0 5 4 -1, 1 2 7 -1, 7 6 1 -1, 3 4 7 -1, 7 2 3 -1]
      texCoordIndex [4 7 6 5 1 0 3 2]
      colorTexture            ImageTexture   { url "../pix/245.png" }
      printingMaterialTexture  ImageTexture   { url "../material/245_material.png" }
    }
  ]
}
```

Page 273, Clause 6

Insert the following clause.

6 Web3D Coding

6.1 General

This document describes a scene representation using a JSON schema. The reason for choosing JSON is the native support by modern browsers and easiness of integration with javascript. The JSON schema is used to connect the object 2graph elements, MPEG AFX tools, images and shaders. The main components of the library (see Figure 82) are the JSON parser and the GraphicsCodec, whereas the GraphicsCodec contains both the SC3DMC and BBA decoders. The input of the library is the JSON description file. The JSON Parser analyses its data and calls the appropriate decoders, the SC3DMC decoder for the mesh data and BBA decoder for the animated data. The output of the decoders is then used to initialize the corresponding glIndexedFaceSet structures that are then used by the WebGL engine to render the scene.