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Title: Response to the CfP on Advanced Text and 2D Graphics

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This document proposes some solutions to fulfill some of the requirements expressed in the Call for Proposals issued by the MPEG-4 Systems group. The proposed solutions mainly address the 2D graphics part of the requirements.

The solutions which are described in this document are all backward compatible and do not invalidate existing bit streams. They are based on the definition of new nodes or the extension of existing nodes with the addition of new fields. In the latter case, care has been taken to add field to nodes where there was space left in the node coding table. This way of extension is very efficient in terms of compression. It is also less confusing because it groups several levels of complexity for the same functionality in the same node. Of course, if this solution is to be chosen by the group, it will require to clarify the existing profiles by saying that if any field is added to a node in future version of the standard these fields will not be supported in these profiles. Moreover, special care need to be taken that extension fields do not modify the behavior of existing fields.

Requirement #1:

> It shall be possible to allow the use of a viewport in conjunction with Layer2D, with all appropriate options to deal with possible differences of aspect ratio between the viewport and the enclosing Layer2D.

Proposal

To fulfill this requirement, we propose the creation of the Viewport node (previously presented as Viewpoint2D in N7865) of type SFViewportNode. This node adds 3 new aspects to the standard: first the ability for the content to adapt itself to the size of the terminal it is displayed on; second, the bindability of this node allows for navigating in a 2D scene as with the Viewpoint node in a 3D scene; and finally, it allows for viewing part of the scene with some constraints on the aspect ratio.

9.4.2.X Viewport

9.4.2.X.1 Node interface

```
Viewport {
   eventIn        SFBool     set_bind
   exposedField   SFVec2F    position                 0 0
   exposedField   SFVec2F    size                     -1 -1
   exposedField   SFFloat    orientation              0
   field          MFInt32    alignment                [ 0 0 ]
   field          SFInt32    fit                      0
   field          SFString   description              “”
   eventOut       SFTime     bindTime
   eventOut       SFBool     isBound
}
```

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

9.4.2.X.2 Functionality and semantics

A **Viewport** node is placed in the **viewport** field of a **Layer2D** or **CompositeTexture2D** node. It defines a new viewport and implicitly establishes a new local coordinate system. The bounds of the new viewport are defined by the **size** and **position** field. The new local coordinate system’s origin is at the center of the parent node in the parent’s local coordinate system.
The **orientation** field specifies the rotation which is applied to the viewport in the parent node’s local coordinate system with respect to the X-axis.

Viewport nodes are bindable nodes (see 9.2.2.14) and thus there exists a **Viewport** node stack which follows the same rules than other bindable nodes (e.g. **Background2D**).

The **description** field specifies a textual description of the **Viewpoint2D** node.

The **alignment** and **fit** fields specify how the viewing area is mapped to the rendering area of the parent node (i.e. **Layer2D**, **CompositeTexture2D**, or the 2D top-node).

If the **fit** field is set to 0, the viewing area is scaled to fit the rendering area without preserving the aspect ratio.
If the **fit** field is set to 1, the viewing area is scaled preserving the aspect ratio to fit entirely inside the rendering area. The scaling operation is performed possibly after rotation as specified by the **orientation** field.
If the **fit** field is set the 2, the viewing area is scaled preserving the aspect ratio to cover entirely the rendering area. The scaling operation is performed possibly after rotation as specified by the **orientation** field.

The **alignement** field is an MFInt32 field that contains two values. The first value specifies alignment along the X-axis and the second value specifies alignment along the Y-axis. The first value belongs to the following set of SFInt32: -1, 0, 1. The second value belongs to the following set of SFInt32: -1, 0, 1. An empty **alignement** field is equivalent to the default value. When the **fit** field is set to 0, the **alignment** field is ignored. The meaning of the different values of the **fit** and **alignment** fields is described in the following figure.

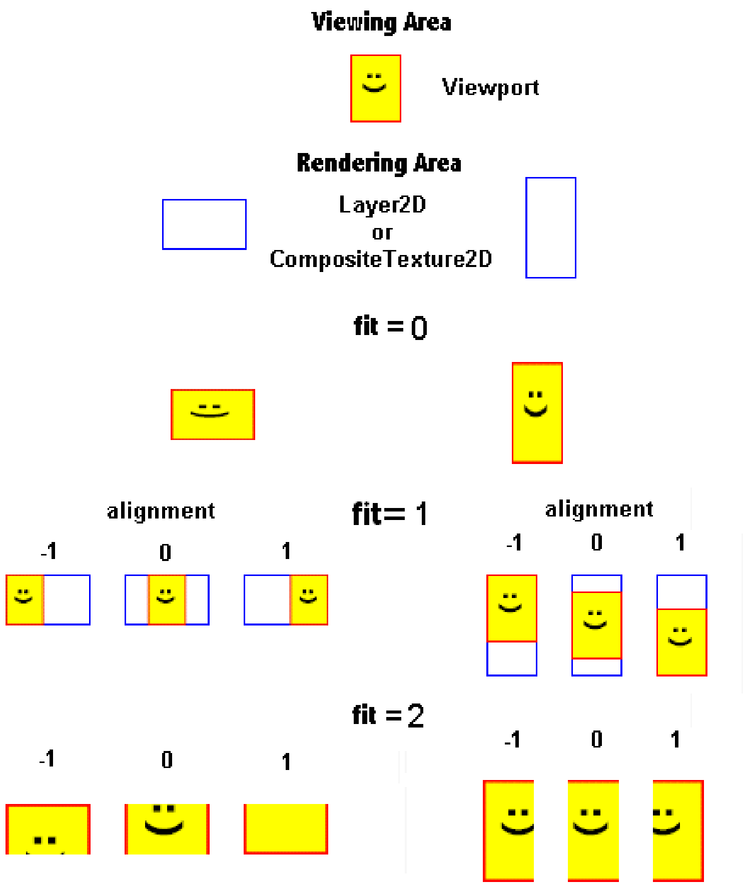


Figure 1: description of alignment and fit fields

Requirement #2

It shall be possible to allow the use a 2x3 matrix to specify a 2D transformation.

Proposal

To fulfill this requirement, we propose the creation of the following new node.

9.4.2.X TransformMatrix2D

9.4.2.X.1 Node interface

```
TransformMatrix2D {
    eventIn        MFNode     addChildren
    eventIn        MFNode     removeChildren
    exposedField   MFNode     children         []
    exposedField   MFFloat    matrix           [ 1 0 0 0 1 0 ]
}
```

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

9.4.2.X.2 Functionality and semantics

The **TransformMatrix2D** node is a grouping node that defines a coordinate system for its children that is relative to the coordinate systems of its ancestors. See ISO/IEC 14772-1:1998 for a description of coordinate systems and transformations and for a description of the **children**, **addChildren**, and **removeChildren** fields and eventIns.

The **matrix** field defines a geometric 2D transformation based on the following transformation matrix, where *matrix$_i$* is the i-th SFFloat in the **matrix** field:

$$T = \begin{pmatrix} matrix_1 & matrix_2 & matrix_3 \\ matrix_4 & matrix_5 & matrix_6 \\ 0 & 0 & 1 \end{pmatrix}$$

Given a 2-dimensional point P and **TransformMatrix2D** node, P is transformed into point P' in its parent's coordinate system by the transformation whose matrix is T.

$$P' = T \times P$$

The behaviour of **TransformMatrix2D** with respect to the **Sound2D** node is the same as the behaviour of the **Transform2D** node.

The **addChildren** and **removeChildren** eventIns are used to add or remove child nodes from the children field of the node as for a **Transform2D** node.

Requirement #3

It shall be possible to draw circular, parabolic and elliptical arcs.

Proposal

The following types of drawing are allowed in SVG:

- The "moveto" commands
- The "closepath" command
- The "lineto" commands
- The curve commands
- The cubic Bézier curve commands
- The quadratic Bézier curve commands
- The elliptical arc curve commands

Each type of command (except the closepath one) is duplicated to allow relative and absolute positioning of coordinates.

BIFS currently allows to perform some of the SVG commands: moveTo, lineTo and Bézier curves (since quadratic Bézier curves can be expressed in term of cubic Bézier curve), with absolute positioning. We propose to add to BIFS the ability to perform all the other SVG commands.

The node which seems the most appropriate for this functionality is Curve2D. Fortunately, it holds only three fields which gives the opportunity to introduce a new field for the purpose of drawing circular, parabolic and elliptical arcs.
The principle of this proposal is to add a new field to the Curve2D node. This field is called enhancedType. When not empty, it supersedes the type field, i.e. the coordinate

pairs of the point field of the Coordinate2D node are consumed following the values of the enhancedType field.
Care has been taken that:

- a reserved value is left for future extensions of the type field (parabolic arcs, predictive coding),
- and the added types are consistent with the previous ones. For example, elliptical arcs could be drawn without the knowledge of focal points but with angle and sweeping information but then it would not be consistent with the use of the Coordinate2D node.

The Curve2D node would become as follows.

9.4.2.X Curve2D

9.4.2.X.1 Node interface

```
Curve2D {
   exposedField    SFNode     point          NULL
   exposedField    SFInt32    fineness       0.5
   exposedField    MFInt32    type           []
   exposedField    MFInt32    enhancedType   []
}
```

9.4.2.X.2 Functionality and semantics

[…]

The permitted values of **enhancedType** are:

- 0 = MoveTo: Same as the value 0 for the **type** field. Moreover, the coordinate pair consumed from the **point** list also defines the starting point of the new subpath **P0**. MoveTo shall not occur neither as the first element in **enhancedType** field.

- 1 = LineTo: Same as the value 1 for the **enhancedType** field.

- 2 = CurveTo: Same as the value 2 for the **enhancedType** field.

- 3 = NextCurveTo: Same as the value 3 for the **enhancedType** field.

- 4 = IncreasingArcTo: Three coordinate pairs in the **point** list are consumed, defining **F1**, **F2** and **N**. **F1** and **F2** are the focal points of the ellipse to which **P** and **N** belong. On this ellipse, **P** and **N** define two arcs. Considering the polar parametric representation of the ellipse $\left(rx\cdot\cos(\theta), ry\cdot\sin(\theta)\right)$ and assuming that **F1** is the focal point with the negative coordinate on the x-axis, the drawn arc is the one that corresponds to an increase of θ when sweeping the arc from **P** to **N**.

- 5 = DecreasingArcTo: Same as IncreasingArcTo except that the drawn arc is the one that corresponds to a decrease θ when sweeping the arc from **P** to **N**.

- 6 = ClosePath: No coordinate pair is consumed from the **point** list. Close the current subpath by drawing a straight line from **P** to the current subpath's initial point **P0**. If a ClosePath is followed immediately by any other command than a MoveTo or RelativeMoveTo, then the next subpath starts at the same initial point as the current subpath, i.e. **P0**. Note: The difference between closing the subpath and explicitly drawing a line between **P** and **P0** is that in the first case the line in **P0** will be closed with the current value of line-join while in the second case the line will be closed using the current value of line-cap.

- 7 = Reserved

Requirement #4

It shall be possible to:

- render text on a baseline that follows any path/curve.
- easily combine individual text objects with different decorations to build a continuous text

Proposal

We propose the definition a new SFGeometryNode node called TextSpan. The new node definition would allow to apply transformation over the positioning of the text contained in several Text nodes. This would make possible to position some text along a path or a curve and also to put several text together. It would behave differently with regards to filling and stroking than the Text node therefore allowing fill, stroking and texture as for other SFGeometryNode nodes.

The new node to be defined is called TextSpan. It uses the notion of index that was used for the IndexedFaceSet or IndexedLineSet nodes. For this new node, the indices are used to reference characters or glyphs.

9.4.2.X TextSpan

9.4.2.X.1 Node interface

```
TextSpan {
    eventIn         MFNode      addChildren
    eventIn         MFNode      removeChildren
    exposedField    MFNode      children              []
    exposedField    SFInt32     adjust                0
    exposedField    MFVec2F     bBox                  -1, -1
    exposedField    MFNode      fontStyles            []
    exposedField    MFFloat     fontStyleIndex        []
    exposedField    MFFloat     orientation           []
    exposedField    MFFloat     orientationIndex      []
    exposedField    SFNode      translation           []
    exposedField    MFInt32     translationIndex      []
    exposedField    SFNode      color                 []
    exposedField    MFInt32     colorIndex            []
    exposedField    SFNode      path                  []
    exposedField    SFFloat     startOffset           0
}
```

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

9.4.2.X.2 Functionality and semantics

The **addChildren** and **removeChildren** are identical to the **addChildren** and **removeChildren** eventIn of the **Transform2D** node.
The **children** field shall only contain **Text** or **TextSpan** nodes.

The **adjust** field specifies if the text content from the **children** field shall be adjusted to fit in a bounding box as defined by the **bBox** field. Three values are allowed: 0 means no adjustment, 1 means only spaces shall be stretched and 2 means both spaces and glyphs are adjusted.

The **fontStyles** field shall list the **FontStyle** nodes to be used to render the text content of the **children** field. When **fontStyleIndex** is empty, the FontStyle node to be used is the one specified by each **Text** node (either explicitly or default). Otherwise, the **fontStyleIndex** fields determines the **FontStyle** of each character contained in all the **Text** or **TextSpan** nodes. If there are more **FontStyle** nodes than characters, the remaining nodes are ignored. If there are less nodes than characters, the remaining characters use the last **FontStyle** node.

The **orientation** field shall list the rotations to be applied to each character of the text content of the **children** field. When **orientation** is empty, no rotation is applied for this node. An other **TextSpan** node can possibly specify the **orientation** field for its content. Otherwise, the **orientation** fields determines the rotation of each character contained in all the **Text** or **TextSpan** nodes. If there are more angles specified in the **orientation** field than characters, the remaining angles are ignored. If there are less angles than characters, the remaining characters use the last angle.

The **translation** field shall list the translation to be applied to each character of the text content of the **children** field. When **translation** is empty, no translation is applied for this node. An other **TextSpan** node can possibly specify the **translation** field for its content. Otherwise, the **translation** fields determines the translation of each character contained in all the **Text** or **TextSpan** nodes. If there are more SFVec2F specified in the **translation** field than characters, the remaining SFVec2F are ignored. If there are less SFVec2F than characters, the remaining characters use the last SFVec2F.

The **color** and **colorIndex** field act as for the **IndexedLineSet2D** node except that the vertices are replace by the characters contained in the **children** field, that there is no color interpolation and that the top most **TextSpan** node has precedence to set the color of the characters.

The **path** field contains an SFGeometry node along which the text is to be rendered. The **startOffset** field determines the offset to be used along the shape before starting to render the text.

Requirement #5

It shall be possible to:

- define the shape of each character in a font using a set of Shape nodes

Proposal

The following node allows for defining user font data such as glyphs, font data (i.e. mapping of characters to glyphs, size of the glyphs, position of the glyphs, ascent, descent …).

9.4.2.X FontData

9.4.2.X.1 Node interface

FontData {

Field	SFString	**fontName**	“”
Field	MFNode	**glyphs**	[]
Field	MFString	**glyphsRefs**	[]
Field	SFNode	**missingGlyphs**	NULL
Field	SFInt32	**weight**	0
Field	SFInt32	**cap-height**	0
Field	SFInt32	**x-height**	0
Field	SFInt32	**ascent**	0
Field	SFInt32	**units-per-em**	0
Field	SFString	**style**	“NORMAL”
Field	MFInt32	**baseline-data**	[]

}

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

Requirement #6

It shall be possible to:

- use line properties line-cap and line-join whose properties can be respectively butt, round, square or miter, round, bevel.
- texture the (wide) outline of shapes (including text)

Proposal

To satisfy theses requirements, we propose the definition of the following SFLineProperties node.

9.4.2.X XLineProperties

9.4.2.X.1 Node interface

XLineProperties {

exposedField	SFColor	**lineColor**	0, 0, 0
exposedField	SFInt32	**lineStyle**	0
exposedField	SFFloat	**width**	1.0
Field	SFBool	**isScalable**	TRUE
exposedField	SFInt32	**lineCap**	0
exposedField	SFInt32	**lineJoin**	0
exposedField	SFInt32	**miterlimit**	4
exposedField	SFFloat	**transparency**	0.0
exposedField	SFNode	**texture**	NULL
exposedField	SFNode	**textureTransform**	NULL

}

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

9.4.2.X.2 Functionality and semantics

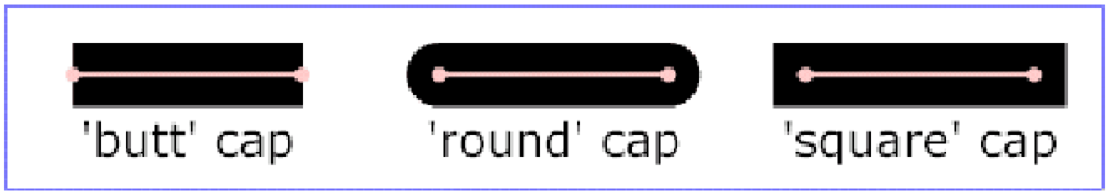
The **XLineProperties** node specifies line parameters used in 2D and 3D rendering.
The **lineColor** and the **lineStyle** fields are the same as for the LineProperties node.
The

The **width** field determines the width, in the local coordinate system, of rendered lines. The width is subject to scaling only when the **isScalable** field is set.

The **lineCap** field shall contain the line cap style type to apply to lines. The allowed values are:

Table - lineCap **description**

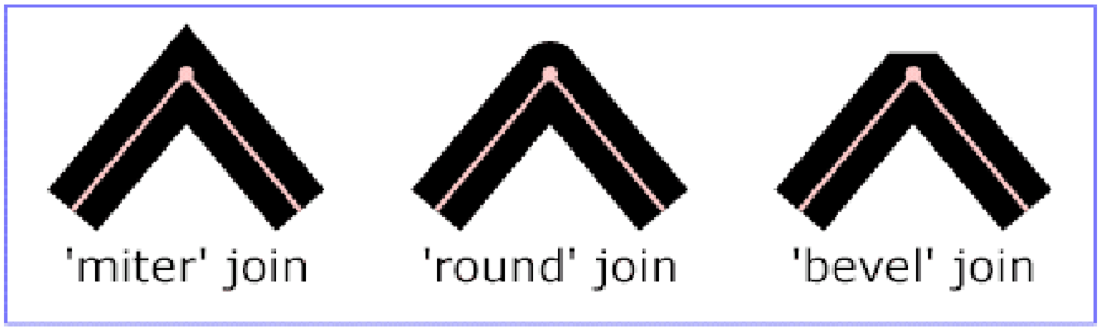
lineCap	Description
0	butt
1	round
2	square



The **lineJoin** field shall contain the line join style type to apply to lines. The allowed values are:

Table - lineJoin **description**

lineJoin	Description
0	miter
1	round
2	bevel



The **miterlimit** field shall contain the limit on the ratio of the miter length to the line width as specified in the **width** field. The value of **miterlimit** must be a number greater than or equal to 1.

The **transparency** field specifies the transparency of the of the outline of a Shape when drawn. It supersedes the value of the transparency of a material node.

The **texture** and **textureTransform** fields are identical to those of an **Appearance** node except that texture is only applied to the outline of the shape using the same bounding box as for texturing the whole shape.

Requirement #7

It shall be possible to:

- use gradient and patterns as textures

Proposal

We propose to use the LinearGradient and RadialGradient nodes as defined in AFX [1] to perform gradient but we would like to define them as SFTextureNode instead of SFMaterialNode. As for Patterns, we propose to add the repeatS and repeatT fields to the compositeTexture2D and 3D nodes. Since, compositeTexture2D already has 7 fields we suggest to add one field holding both booleans, some sort of MFBool (**repeatSandT**).

Annex C: Registration form

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Title of submission:	**Response to the CfP on Advanced Text and 2D Graphics**
Abstract:	This document proposes some solutions to fulfill some of the requirements expressed in the Call for Proposals issued by the MPEG-4 Systems group. The proposed solutions mainly address the 2D graphics part of the requirements. The solutions which are described in this document are all backward compatible and do not invalidate existing bit streams. They are based on the definition of new nodes or the extension of existing nodes with the addition of new fields.
Time requested for presentation (subject to review by organisers):	
Demo intended:	No
Equipment and other support required for demo:	

Name:

Date:

Signatures :

References:

1. SVG 1.1, W3C, chapter 8, Paths: http://www.w3.org/TR/SVG11/paths.html
2. SVG 1.1, W3C, chapter 10, Text: http://www.w3.org/TR/SVG11/text.html
3. VRML 97, ISO/IEC 14772-1:1997, chapter 6, Node Reference: http://www.web3D.org/technicalinfo/specifications/vrml97/part1/nodesRef.html
4. CSS 2, W3C, chapter 15, Fonts: http://www.w3.org/TR/REC-CSS2/fonts.html
5. XSL, W3C, chapter 7, Formatting Properties: http://www.w3.org/TR/xsl/slice7.html#common-font-properties
6. Postscript Language Reference, Third Edition, Adobe Systems Inc., http://www.adobe.com/products/postscript/pdfs/PLRM.pdf