INTERNATIONAL ORGANISATION FOR STANDARDISATION

ORGANISATION INTERNATIONALE DE NORMALISATION

ISO/IEC JTC1/SC29/WG11

CODING OF MOVING PICTURES AND AUDIO

ISO/IEC JTC1/SC29/WG11

MPEG2004/M10684

March 2004, Munich DE

Source: ENST and France Telecom

Status: Proposal

Title: Support of SVG1.2 for LASER

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Introduction

It is important to leverage industry's growing acceptance of SVG to improve LASER chances of success. In particular, in the mobile arena, 3GPP mandates the use of SVG Tiny in its releases 5 and 6 within the framework of MMS. Thus, SVG is seen by many actors as a must, and supporting a subset of SVG in LASER would be a great asset.

Yet SVG has the same problems as BIFS in terms of size and performance. Even though one SVG profile is called Tiny, its implementations are well above the target range of LASER:

- BitFlash website: SVG Tiny player on mobiles usually around 500K (870K with scripting).
- CSIRO player for PocketPC (from W3C website): 390K
- eSVG player for PocketPC: around 500K (plus maybe DLLs)

With hindsight, BIFS was not so bad with IBM's Java player around 400K (including video and audio decoding).

There is at www.tinyline.com, a Java implementation of a small subset of SVG, called Tinyline (version 1.6). The author calls the implemented subset SVG Minute. 30 of the 32 elements of SVG Tiny are implemented, and definitely not all attribute combinations. The result is still of amazingly good quality, with a code size of 168K (class files = memory usage in the handheld), and 95.1K (zipped in a JAR file = size of installer message when sent over the air). Our evaluation of the code is that its quality is very high, and we believe it is an excellent reference point.

To achieve the LASER target of 50-100K, there is a definite need for drastic profiling of SVG Tiny. By comparison and to prove this target is feasible, our proto-LASER Java player has a code size of 79.5K(classes) and 42.7K(zipped).

SVG Complexity and Profiling

Estimation of the Problem Scale

As there was "node bloat" in BIFS, there seems to be "feature bloat" in SVG, already in the so-called "Tiny" profile. In this document, we propose a way of measuring the complexity of the standard. In SVG Tiny, there are 32 XML elements (nodes in BIFS), with an average **20** XML attributes (fields in BIFS) per element. The total size is close to 700 allowed element-attribute pairs in total. The list is given in an annex to this document. No wonder the code size in the 500K range.

By comparison, our proto-LASER solution has 30 element-attribute pairs for SAF and 180 for LASER, including 30 for BIFS-like updates and 150 for scene.

So the target is a **feature reduction of 4 to 8**.

Binary vs. XML Text

Our proto-LASER implementation includes a binary parser à la BIFS: clearly, binary parsing is smaller and faster than XML parsing. Here is an estimation of the difference in size.

In Tinyline, the parser size is approximately 66K (classes) and 30K (zipped). This accounts for an incomplete SVG Tiny (XML) parser, without DOM or scripting.

In our proto-LASER implementation, the parser size is 34.1K (classes) and 14.6K (zipped).

Clearly, with a factor of 2 in code size, and a significant speed up (not measured), a binary format is much better for small embedded devices.

SVG Tiny Features

SVG is loaded with authoring facilities and features useful in text but painful in binary. These features are definitely assets in the PC/Internet world, where easy textual authoring is a key to the acceptance of a format. The mobile world does not have these requirements, and can even be said to have conflicting requirements. Here is a list of problematic features:

- switch: the SVG switch is a construct that enables a **varying "level of requirements" within one scene**. While this is a very handy capability for device independence, it is much too complex for embedded devices.
- **property inheritance:** the ability to place e.g. a color on the primitives or on any of the elements above it is again useful in terms of authoring, but multiplies the number of possibilities, hence the complexity of the code to implement the "color with inheritance" feature.
- multiple primitives when path/shape can do it all: having "rect" and "path" is not useful on embedded devices, because what "rect" does, "path" can do very easily. Thus, only "path" is needed as a graphics primitive.
- foreignObject: SVG has an element for including "something else" in the scene tree. This is as close as ApplicationWindow node of BIFS as we can think. This could intended to be used for e.g. video. Clearly, MPEG (and SMIL) has another way of doing it, by defining Audio and Video elements.
- complete text rendering system: the complexity of the text rendering systems is big. We have recently acknowledged within MPEG the need for better text, but the SVG text level is still overkill for the smallest devices.

- multiple ways of doing something: SVG does not have the “one-tool-one-functionality” principle that MPEG has, and this can be felt throughout the spec.
- in SVG 1.2: the SVG WG has decided to put simple gradients and text flow layout in SVG Tiny, something that brings SVG Tiny even further than the target code size.
- path specification with all those options: the multiple types of curves that path can do are overkill on small devices.
- multiple transform specifications: the ability to specify transformations in multiple ways has a high cost in lines of codes
- color keywords: the ability to specify colors by keyword is very expensive in terms of 1) code size: the table needed to convert the names to RGB and 2) compression: the encoding of strings is worse than the encoding of RGB.
- defs: this grouping of the DEFed elements is “nice” but does not help code size or implementability in any way, because it is optional. Moreover, it can be done with existing nodes. Therefore, we want to remove it.

Required Extensions

To accommodate some of MPEG assets in graphics, here are proposed extensions of SVG:

- Audio and Video elements
- updates à la BIFS: Insert/Replace/Delete, value/node/indexed… to replace the “discarded” XML Events.
- cursor, textual input and keyboard management:
    - cursor: for terminals without pen or mouse (the majority), the ability to designate an actual shape in the content to be a virtual cursor is very effective. This virtual cursor/shape is to be moved by key presses (e.g. with the joystick which emulates key presses), and when the “FIRE” button is pressed, the current position of the virtual cursor is used instead of a mouse position.
    - textual input: this is an interface to the typing assistance software available in most terminals.
    - keyboard management: basically, this is the BIFS KeySensor (specialisation of the InputSensor).
- declarative scripting : as programmatic scripting is too expensive for the target code sizes, we suggest to use BIFS-like scripting, based on concepts close to Conditional, Valuator …
- the ability to save and restore small chunks of data in an application-linked manner has been found key to many mobile services. This should be done in the manner of the RMS feature of MIDP1.0.

Proposed Profile

To be discussed with SVG experts, here is a first shot at pruning SVG Tiny. For easier reading, we have used color coding in the annex describing all of the SVG Tiny 1.1 features:

- red/italics means not included
- blue/plain means under consideration for a higher profile of LASER

- black/bold means proposed for inclusion in LASER.

Acknowledgements

Some of the work leading to this contribution was funded by the European Commission as part of the DANAE Project.

Annex: all of SVG Tiny allowed element-field pairs

defs	container for elements with ids
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space
defs.requiredFeatures	
defs.requiredExtensions	
defs.systemLanguage	
defs.transform	

desc	textual description of the content
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space

g	grouping node
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space
g.requiredFeatures	
g.requiredExtensions	
g.systemLanguage	
g.transform	

metadata	“MPEG-7” element
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space

svg	top node
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space
svg.requiredFeatures	
svg.requiredExtensions	
svg.systemLanguage	
svg.x	
svg.y	
svg.width	
svg.height	
svg.viewBox	
svg.preserveAspectRatio	
svg.zoomAndPan	
svg.version	
svg.baseProfile	

title	title of the content
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space

use	reference to an ID-ed element
*.id	DEF name

*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
use.requiredFeatures	
use.requiredExtensions	
use.systemLanguage	
use.transform	
use.x	
use.y	
use.width	
use.height	
use.xlink:type	
use.xlink:href	
use.xlink:role	
use.xlink:arcrole	
use.xlink:title	
use.xlink:show	
use.xlink:actuate	
use.GraphicsElementEventAttrs	

a	**Anchor**
***.id**	**DEF name**
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
a.requiredFeatures	
a.requiredExtensions	
a.systemLanguage	
a.transform	
a.target	
a.xlink:type	
a.xlink:href	
a.xlink:role	
a.xlink:arcrole	
a.xlink:title	
a.xlink:show	
a.xlink:actuate	

switch ***The 'switch' element evaluates the requiredFeatures, requiredExtensions and systemLanguage attributes on its direct child elements in order, and then processes and renders the first child for which these attributes evaluate to true. All others will be bypassed and therefore not rendered***

_*.id_	_DEF name_
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
switch.requiredFeatures	
switch.requiredExtensions	
switch.systemLanguage	
switch.transform	

circle	
_*.id_	_DEF name_
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
circle.requiredFeatures	
circle.requiredExtensions	
circle.systemLanguage	
circle.color	

```
circle.fill
circle.fill-rule
circle.stroke
circle.stroke-dasharray
circle.stroke-dashoffset
circle.stroke-linecap
circle.stroke-linejoin
circle.stroke-miterlimit
circle.stroke-width
circle.color-rendering
circle.display
circle.visibility
circle.cx
circle.cy
circle.r
circle.transform

ellipse
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
ellipse.requiredFeatures
ellipse.requiredExtensions
ellipse.systemLanguage
ellipse.color
ellipse.fill
ellipse.fill-rule
ellipse.stroke
ellipse.stroke-dasharray
ellipse.stroke-dashoffset
ellipse.stroke-linecap
ellipse.stroke-linejoin
ellipse.stroke-miterlimit
ellipse.stroke-width
ellipse.color-rendering
ellipse.display
ellipse.visibility
ellipse.cx
ellipse.cy
ellipse.rx
ellipse.ry
ellipse.transform

line
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
line.requiredFeatures
line.requiredExtensions
line.systemLanguage
line.color
line.fill
line.fill-rule
line.stroke
line.stroke-dasharray
line.stroke-dashoffset
line.stroke-linecap
line.stroke-linejoin
line.stroke-miterlimit
```

line.stroke-width	
line.color-rendering	
line.display	
line.visibility	
line.x1	
line.y1	
line.x2	
line.y2	
line.transform	

path	
***.id**	**DEF name**
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
path.requiredFeatures	
path.requiredExtensions	
path.systemLanguage	
path.transform	
path.d	
path.pathLength	
path.color	
path.fill	
path.fill-rule	
path.stroke	
path.stroke-dasharray	
path.stroke-dashoffset	
path.stroke-linecap	
path.stroke-linejoin	
path.stroke-miterlimit	
path.stroke-width	
path.color-rendering	
path.display	
path.visibility	

polygon	
_*.id_	_DEF name_
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
polygon.requiredFeatures	
polygon.requiredExtensions	
polygon.systemLanguage	
polygon.color	
polygon.fill	
polygon.fill-rule	
polygon.stroke	
polygon.stroke-dasharray	
polygon.stroke-dashoffset	
polygon.stroke-linecap	
polygon.stroke-linejoin	
polygon.stroke-miterlimit	
polygon.stroke-width	
polygon.color-rendering	
polygon.display	
polygon.visibility	
polygon.points	
polygon.transform	

polyline	
_*.id_	_DEF name_

```
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
polyline.requiredFeatures
polyline.requiredExtensions
polyline.systemLanguage
polyline.color
polyline.fill
polyline.fill-rule
polyline.stroke
polyline.stroke-dasharray
polyline.stroke-dashoffset
polyline.stroke-linecap
polyline.stroke-linejoin
polyline.stroke-miterlimit
polyline.stroke-width
polyline.color-rendering
polyline.display
polyline.visibility
polyline.points
polyline.transform

rect
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
rect.requiredFeatures
rect.requiredExtensions
rect.systemLanguage
rect.color
rect.fill
rect.fill-rule
rect.stroke
rect.stroke-dasharray
rect.stroke-dashoffset
rect.stroke-linecap
rect.stroke-linejoin
rect.stroke-miterlimit
rect.stroke-width
rect.color-rendering
rect.display
rect.visibility
rect.x
rect.y
rect.width
rect.height
rect.rx
rect.ry
rect.transform

image
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
image.xlink:type
image.xlink:href
image.xlink:role
image.xlink:arcrole
image.xlink:title
image.xlink:show
image.xlink:actuate
image.requiredFeatures
image.requiredExtensions
image.systemLanguage
image.preserveAspectRatio
image.color
image.fill
image.fill-rule
image.stroke
image.stroke-dasharray
image.stroke-dashoffset
image.stroke-linecap
image.stroke-linejoin
image.stroke-miterlimit
image.stroke-width
image.color-rendering
image.display
image.visibility
image.overflow
image.transform
image.x
image.y
image.width
image.height

text
*.id                        DEF name
*.xml:base                  change base for relative urls
*.xml:lang                  language identifiers
*.xml:space                 preserve white space
text.requiredFeatures
text.requiredExtensions
text.systemLanguage
text.transform
text.x
text.y
text.rotate
text.color
text.fill
text.fill-rule
text.stroke
text.stroke-dasharray
text.stroke-dashoffset
text.stroke-linecap
text.stroke-linejoin
text.stroke-miterlimit
text.stroke-width
text.color-rendering
text.font-family
text.font-size
text.font-style
text.font-weight
text.display
text.visibility
text.text-anchor
text.alignment-baseline
text.baseline-shift
text.direction
text.dominant-baseline
text.glyph-orientation-horizontal
text.glyph-orientation-vertical
text.kerning
text.letter-spacing
text.text-anchor
text.text-decoration
text.unicode-bidi
text.word-spacing
text.writing-mode

font
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
font.horiz-origin-x
font.horiz-adv-x

font-face               font description
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
font-face.font-family
font-face.font-style
font-face.font-variant
font-face.font-weight
font-face.font-stretch
font-face.font-size
font-face.unicode-range
font-face.units-per-em
font-face.panose-1
font-face.stemv
font-face.stemh
font-face.slope
font-face.cap-height
font-face.x-height
font-face.accent-height
font-face.ascent
font-face.descent
font-face.widths
font-face.bbox
font-face.ideographic
font-face.alphabetic
font-face.mathematical
font-face.hanging
font-face.underline-position
font-face.underline-thickness
font-face.strikethrough-position
font-face.strikethrough-thickness
font-face.overline-position
font-face.overline-thickness

font-face-name          ?
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
font-face-name.name

font-face-src           ?
*.id                    DEF name
```

*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_

glyph	graphics for a given character
*.id	DEF name
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
glyph.unicode	
glyph.glyph-name	
glyph.d	
glyph.arabic-form	
glyph.lang	
glyph.horiz-adv-x	

hkern	kerning pairs and adjustment values in the hor. advance value
*.id	DEF name
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
hkern.g1	
hkern.g2	
hkern.u1	
hkern.u2	
hkern.k	

missing-glyph	graphics to use for a glyh not in the font
*.id	DEF name
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
missing-glyph.d	
missing-glyph.arabic-form	
missing-glyph.lang	
missing-glyph.horiz-adv-x	

__animate__	__used to animate a single attribute or property over time__
__*.id__	__DEF name__
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
animate.requiredFeatures	
animate.requiredExtensions	
animate.systemLanguage	
__animate.onbegin__	
__animate.onend__	
__animate.onrepeat__	
__animate.onload__	
animate.xlink:type	
animate.xlink:href	
animate.xlink:role	
animate.xlink:arcrole	
animate.xlink:title	
animate.xlink:show	
animate.xlink:actuate	
__animate.attributeName__	
__animate.attributeType__	
__animate.begin__	
__animate.dur__	
animate.end	

animate.min	
animate.max	
animate.restart	
animate.repeatCount	
animate.repeatDur	
animate.fill	
animate.calcMode	
animate.values	
animate.keyTimes	
animate.keySplines	
animate.from	
animate.to	
animate.by	
animate.additive	
animate.accumulate	

animateColor	**ColorInterpolator**
***.id**	**DEF name**
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_
animateColor.requiredFeatures	
animateColor.requiredExtensions	
animateColor.systemLanguage	
animateColor.onbegin	
animateColor.onend	
animateColor.onrepeat	
animateColor.onload	
animateColor.xlink:type	
animateColor.xlink:href	
animateColor.xlink:role	
animateColor.xlink:arcrole	
animateColor.xlink:title	
animateColor.xlink:show	
animateColor.xlink:actuate	
animateColor.attributeName	
animateColor.attributeType	
animateColor.begin	
animateColor.dur	
animateColor.end	
animateColor.min	
animateColor.max	
animateColor.restart	
animateColor.repeatCount	
animateColor.repeatDur	
animateColor.fill	
animateColor.calcMode	
animateColor.values	
animateColor.keyTimes	
animateColor.keySplines	
animateColor.from	
animateColor.to	
animateColor.by	
animateColor.additive	
animateColor.accumulate	

animateMotion	**PositionInterpolator**
***.id**	**DEF name**
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_

animateMotion.requiredFeatures
animateMotion.requiredExtensions
animateMotion.systemLanguage
__animateMotion.onbegin__
__animateMotion.onend__
__animateMotion.onrepeat__
__animateMotion.onload__
animateMotion.xlink:type
animateMotion.xlink:href
animateMotion.xlink:role
animateMotion.xlink:arcrole
animateMotion.xlink:title
animateMotion.xlink:show
animateMotion.xlink:actuate
__animateMotion.begin__
__animateMotion.dur__
animateMotion.end
animateMotion.min
animateMotion.max
__animateMotion.restart__
__animateMotion.repeatCount__
__animateMotion.repeatDur__
__animateMotion.fill__
__animateMotion.additive__
__animateMotion.accumulate__
__animateMotion.calcMode__
__animateMotion.values__
__animateMotion.keyTimes__
__animateMotion.keySplines__
__animateMotion.from__
__animateMotion.to__
__animateMotion.by__
__animateMotion.path__
__animateMotion.keyPoints__
__animateMotion.rotate__
__animateMotion.origin__

__animateTransform__	__animates a transformation attribute__
__*.id__	__DEF name__
*.xml:base	_change base for relative urls_
*.xml:lang	_language identifiers_
*.xml:space	_preserve white space_

animateTransform.requiredFeatures
animateTransform.requiredExtensions
animateTransform.systemLanguage
__animateTransform.onbegin__
__animateTransform.onend__
__animateTransform.onrepeat__
__animateTransform.onload__
animateTransform.xlink:type
animateTransform.xlink:href
animateTransform.xlink:role
animateTransform.xlink:arcrole
animateTransform.xlink:title
animateTransform.xlink:show
animateTransform.xlink:actuate
__animateTransform.attributeName__
__animateTransform.attributeType__
__animateTransform.begin__
__animateTransform.dur__
animateTransform.end

```
animateTransform.min
animateTransform.max
animateTransform.restart
animateTransform.repeatCount
animateTransform.repeatDur
animateTransform.fill
animateTransform.calcMode
animateTransform.values
animateTransform.keyTimes
animateTransform.keySplines
animateTransform.from
animateTransform.to
animateTransform.by
animateTransform.additive
animateTransform.accumulate
animateTransform.type

mpath                   use an existing path for animateMotion
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
mpath.xlink:type
mpath.xlink:href
mpath.xlink:role
mpath.xlink:arcrole
mpath.xlink:title
mpath.xlink:show
mpath.xlink:actuate

set         setting the value of an attribute for a specified duration
*.id                    DEF name
*.xml:base              change base for relative urls
*.xml:lang              language identifiers
*.xml:space             preserve white space
set.requiredFeatures
set.requiredExtensions
set.systemLanguage
set.onbegin
set.onend
set.onrepeat
set.onload
set.xlink:type
set.xlink:href
set.xlink:role
set.xlink:arcrole
set.xlink:title
set.xlink:show
set.xlink:actuate
set.attributeName
set.attributeType
set.begin
set.dur
set.end
set.min
set.max
set.restart
set.repeatCount
set.repeatDur
set.fill
set.to
```

foreignObject	non-SVG element
*.id	DEF name
*.xml:base	change base for relative urls
*.xml:lang	language identifiers
*.xml:space	preserve white space
foreignObject.requiredFeatures	
foreignObject.requiredExtensions	
foreignObject.systemLanguage	
foreignObject.graphicsElementEventAttrs	
foreignObject.transform	
foreignObject.x	
foreignObject.y	
foreignObject.width	
foreignObject.height	
foreignObject.content	

color keywords

multiple transform specifications

path specification with all those options