Scalable Vector Graphics (SVG) 1.2

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Abstract

This document specifies version 1.2 of the Scalable Vector Graphics (SVG) Language, a modularized language for describing two-dimensional vector and mixed vector/raster graphics in XML.

Status of this Document

This section describes the status of this document at the time of its publication. Other documents may supersede this document. A list of current W3C publications and the latest revision of this technical report can be found in the W3C technical reports index at http://www.w3.org/TR/.

This document is the seventh public working draft of the SVG 1.2 specification. This release is identical to the sixth draft, other than Appendix A, the SVG Tiny 1.2 DOM. This release was timed to coincide with the publication of the Java Community Process JSR 226 Expert Group's specification which relies on the SVG Tiny 1.2 DOM.

This draft lists the areas of new work in version 1.2 of SVG and is not a complete language description. The SVG Working Group consider the feature set of SVG 1.2 to be approaching stability. However, there are some cases where the descriptions in this document are incomplete and simply show the current thoughts of the SVG Working Group on the feature, or list the open issues. Therefore, this document should not be considered stable.

This document has been produced by the W3C SVG Working Group as part of the W3C Graphics Activity within the Interaction Domain.

We explicitly invite comments on this specification. Please send them to www-svg@w3.org: the public email list for issues related to vector graphics on the Web. This list is archived and acceptance of this archiving policy is requested automatically upon first post. To subscribe to this list send an email to www-svg-request@w3.org with the word subscribe in the subject line.

The latest information regarding patent disclosures related to this document is available on the Web. As of this publication, the SVG Working Group are not aware of any royalty-bearing patents they believe to be essential to SVG. This document was produced under this Patent Practice.

Publication as a Working Draft does not imply endorsement by the W3C Membership. This is a draft document and may be updated, replaced or obsoleted by other documents at any time. It is inappropriate to cite this document as other than work in progress.

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1 How to read this document and give feedback

This draft of SVG 1.2 is a snapshot of a work-in-progress. The SVG Working Group believe the most of the features here are complete and stable enough for implementors to begin work and provide feedback. Some features already have multiple implementations.

This is not a complete specification of the SVG 1.2 language. Rather it is a list of features that are under consideration for SVG 1.2. In many cases the reader will have to be familiar with the SVG 1.1 language.

The main purpose of this document is to encourage public feedback. The best way to give feedback is by sending an email to www-svg@w3.org. Please include some kind of keyword that identifies the area of the specification the comment is referring to in the subject line of your message (e.g "1.2 compositing" or "1.2 audio and video formats"). If you have comments on multiple areas of this document, then it is probably best to split those comments into multiple messages.

2 Profiling SVG

The creation of SVG Viewers which correspond to profiles other than Tiny, Basic, or Full is discouraged; experience in SVG and other formats shows that proliferation of viewers with subtly differing capabilities is a hindrance to interoperability.

Sometimes, vertically-focused industries can improve interoperability by defining and clearly documenting an industry-specific profile which uses an existing baseProfile as a starting point.

On the other hand, creation of particular profiles for different types of content authoring is encouraged, provided the baseProfile is set appropriately to the closest standard profile which is a true superset of the authoring profile. Use of such documented profiles can aid interchange of graphical assets between authoring tools.

As an example, a profile aimed at technical illustration might be based on SVG Basic, omit filter effects, and retain animation and scripting to allow for interactive diagrams. A profile for interchange of graphics arts assets might be based on Full, retain filter effects, and omit animation, scripting, and foreignObject - thus ensuring that graphics conforming to that profile can be easily edited in a variety of graphical editors.

A future version of the SVG specification might include instructions for defining industry-specific profiles.

3 Text Enhancements

3.1 Flowing Text and Graphics

SVG 1.2 enables a block of text and graphics to be rendered inside a shape, while automatically wrapping the objects into lines, using the flowRoot element. The idea is to mirror, as far as practical, the existing SVG text elements.

3.1.1 The flowRoot element

The flowRoot element specifies a block of graphics and text to be rendered with line wrapping. It contains at least one flowRegion element, defining regions into which the children elements of the flowRoot should be flowed.

The following is an extract of an XML Schema that describes the flowRoot element.

```
<xs:element name="flowRoot">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="flowRegion"/>
      <xs:element ref="flowRegionExclude"/>
      <xs:element ref="flowDiv"/>
    </xs:sequence>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

In order to reduce the burden on Tiny implementations, the Working Group is considering allowing flowPara as a child of flowRoot. This would mean that the Tiny module could require only a single flowPara.

3.1.2 The flowRegion element

The flowRegion element contains a set of shapes and exclusion regions in which the text content of a parent flowRoot element is drawn into. A flowRegion element has basic shapes and path elements as children, as well as a flowRegionExclude element. The children of a flowRegion element are inserted into the rendering tree before the text is drawn, and have the same rendering behavior as if they were children of a g element.

The child elements create a sequence of shapes in which the text content for the parent flowRoot will be drawn into. Once the text fills a shape it flows into the next shape. The flowRegionExclude child describes a set of regions in which text will not be drawn into, such as a cutout from a rectangular block of text.

The child elements of a flowRegion can be transformed as usual, but the text is always laid out in the coordinate system of the flowRoot element. For example, a rect child with a 45 degree rotation transformation will appear as a diamond, but the text will be axis aligned.

The following is an extract of an XML Schema that describes the flowRegion element.

```
<xs:element name="flowRegion">
  <xs:complexType>
    <xs:sequence>
      <xs:choice>
        <xs:group ref="ShapeElements" minOccurs="0" maxOccurs="unbounded"/>
        <xs:element ref="use" minOccurs="0" maxOccurs="unbounded"/>
        <xs:group ref="flowRegionExclude" minOccurs="0" maxOccurs="unbounded"/>
      </xs:choice>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

3.1.3 The flowRegionExclude element

The flowRegionExclude element contains a set of shapes defining regions in which flowed text is not drawn. It can be used to create exclusion regions from within a region of text.

If flowRegionExclude is a child of a flowRegion then it describes an exclusion region for that particular flowRegion. If it is a child of flowRoot then it describes exclusion regions for all flowRegion children of the flowRoot.

The following is an extract of an XML Schema that describes the flowRegionExclude element.

```
<xs:element name="flowRegionExclude">
  <xs:complexType>
    <xs:sequence>
      <xs:group ref="ShapeElements" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="use" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

3.1.4 The flowDiv element

The flowDiv element specifies a block of text and/or graphics to be inserted into the layout, and marks it as a division of related elements. The children of the flowDiv element will be rendered as a block: offset before and after from their parent's siblings. By separating the logical order of text (in successive flowDiv elements) from the physical layout (in regions, which can be presented anywhere on the canvas) the SVG document structure encourages creation of a default, meaningful linear reading order while preserving artistic freedom for layout. This enhances accessibility.

The following is an extract of an XML Schema that describes the flowtext element.

```
<xs:element name="flowDiv">
  <xs:complexType>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="flowPara"/>
      <xs:element ref="flowRegionBreak"/>
    </xs:choice>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.5 The flowPara element

The flowPara element marks a block of text and graphics as a logical paragraph.

The following is an extract of an XML Schema that describes the flowPara element.

```
<xs:element name="flowPara">
  <xs:complexType mixed="true">
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="flowRegionBreak"/>
      <xs:element ref="flowLine"/>
      <xs:element ref="flowTref"/>
      <xs:element ref="flowSpan"/>
      <xs:element ref="flowImage"/>
    </xs:choice>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.6 The flowSpan element

The flowSpan element specifies a block of text to be rendered inline, and marks the text as a related span of words. The flowSpan element is typically used to allow a subset of the text block, of which it is a child, to be rendered in a different style, or to mark it as being in a different language.

The following is an extract of an XML Schema that describes the flowSpan element.

```
<xs:element name="flowSpan">
  <xs:complexType mixed="true">
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="flowSpan"/>
      <xs:element ref="flowLine"/>
      <xs:element ref="flowImage"/>
      <xs:element ref="flowRegionBreak"/>
    </xs:choice>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.7 The flowRegionBreak element

When the flowRegionBreak element is inserted into the text stream it causes the text to stop flowing into the current region at that point. The text after the flowRegionBreak element begins in the next region. If there is no next region, then the text will stop being rendered at the point of the flowRegionBreak.

The following is an extract of an XML Schema that describes the flowRegionBreak element.

```
<xs:element name="flowRegionBreak">
  <xs:complexType/>
</xs:element>
```

3.1.8 The flowLine element

The flowLine element is used to force a line break in the text flow. The content following the end of a flowLine element will be placed on the next available strip in the flowRegion that does not already contain text. This happens even if the flowLine element has no children.

Note that if there are no printing characters between the end of multiple flowLine elements the second and greater flowLine elements have no effect as the current line does not contain any text when they are processed.

In all other aspects, the flowLine element is functionally equivalent to the flowSpan element.

The following is an extract of an XML Schema that describes the flowLine element.

```
<xs:element name="flowLine">
  <xs:complexType mixed="true">
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="flowSpan"/>
      <xs:element ref="flowLine"/>
      <xs:element ref="flowImage"/>
      <xs:element ref="flowRegionBreak"/>
    </xs:choice>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.9 The flowTref element

The flowTref element is used to insert the child text content of a referenced element. It's effect is analogous to the tref element.

The following is an extract of an XML Schema that describes the flowTref element.

```
<xs:element name="flowTref">
  <xs:complexType>
    <xs:attribute ref="href" use="required"
        namespace="http://www.w3.org/1999/xlink"/>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.10 The flowRef element

The flowRef element references a flowRegionElement. It causes the referenced element's geometry to be drawn in the current user coordinate system along with the text that was flowed into the region.

The following is an extract of an XML Schema that describes the flowRef element.

```
<xs:element name="flowRef">
  <xs:complexType>
    <xs:attribute ref="href" use="required"
        namespace="http://www.w3.org/1999/xlink"/>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

3.1.11 The flowImage element

The flowImage element defines a container for graphics which are to be rendered inline in the text layout. It can be used to insert images or any other graphic object that will then flow inline with the text flows.

The flowImage element establishes a new viewport for contained graphic elements. If flowImage specifies an absolute size, that size is used as the bounding rectangle for the flowImage region. If flowImage specifies a percentage as its size, the percentage is represented as a percentage of the current viewport.

In the absence of either width or height on the flowImage element, no new viewport is established. Any contained graphic elements are sized relative to the current viewport. In that case, the bounds of the flowImage element are calculated from the bounding box of any contained child graphic elements.

The following is an extract of an XML Schema that describes the flowImage element.

```
<xs:element name="flowImage">
  <xs:complexType mixed="true">
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="image"/>
      <xs:group ref="ShapeElements"/>
      <xs:element ref="g"/>
    </xs:choice>
    <xs:attribute name="width" type="CoordinateType" use="optional"/>
    <xs:attribute name="height" type="CoordinateType" use="optional"/>
  </xs:complexType>
</xs:element>
```

3.1.12 Text Flow

Text flow is defined as a post processing step to the standard text layout model of SVG. At a high level the steps for flowing text are as follows:

1. The text is then processed in logical order to determine line breaking opportunities between characters, according to Unicode Standard Annex No. 14
2. Text layout is performed as normal, on one infinitely long line, soft hyphens are included in the line. The result is a set of positioned Glyphs.
3. Glyphs are associated with the word who's characters generated it. In cases where characters from multiple words contribute to the same glyph the words are merged and all the glyphs are treated as part of the earliest word in logical order.
4. The glyphs from a word are collapsed into Glyph Groups. A Glyph Group is comprised of all consecutive glyphs from the same word. In most cases each word generates one glyph group however in some cases the interaction between BIDI and special markup may cause glyphs from one word to

have glyphs from other words embedded in it.

5. Each Glyph Group has two extents calculated: is it's normal extent, and it's last in text region extent. It's normal extent is the sum of the advances of all glyphs in the group except soft hyphens. The normal extent is the extent used when a Glyph Group from a later word is in the same text region. The last in text region extent includes the advance of a trailing soft hyphens but does not include the advance of trailing whitespace or combining marks (ABC width?). The last in text region extent is used when this glyph group is from the last word (in logical order) in this text region.
6. The location of the first strip is determined based on the first word in logical order (see Calculating Text Regions and determining strip location).
7. Words are added to the current Strip in logical order. All the Glyph Groups from a word must be in the same strip and all the glyphs from a Glyph Group must be in the same Text Region.

   When a word is added the line height may increase, it can never decrease from the first word. An increase in the line height can only reduce the space available for text placement in the span.

   The span will have the maximum possible number of words.

8. The Glyphs from the Glyph Groups are then collapsed into the text regions by placing the first selected glyph (in display order) at the start of the text region and each subsequent glyph at the location of the glyph following the preceding selected glyph (in display order).
9. The next word is selected and the next strip location is determined. Goto Step 7.

3.1.13 Determining Strip Location

To determine the placement of a strip the Glyph Groups from first word is used. The initial position for the strip is calculated, taking into account the end (in non text progression direction) of the previous strip and the appropriate margin properties.

The line-box is calculated using the initial position as the top/right edge of the line-box, and the line-height of the first word. The 'bottom/right' edge of the line-box must be checked against the margin properties, if it lies within the margin then processing moves to the next flow region.

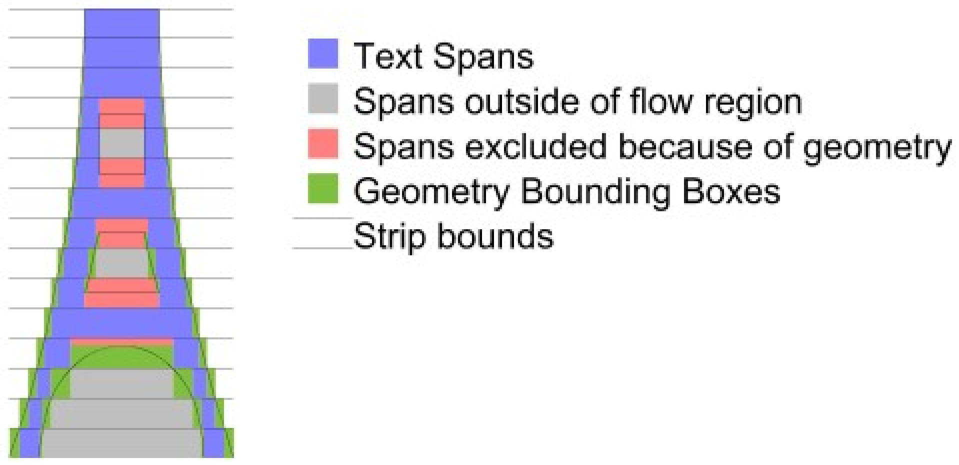
Once the line-box is calculated the Strip and it's associated Text Regions are calculated (see: Calculating Text Regions). If the first word can be placed in the text regions of this Strip then this location is used for the next line of text. If the first word does not fit then the top/right edge is shifted by 'line-advance' and the new line-box is checked. This proceeds until the word fits or end of the flow region is reached at which point processing moves to the next flow region.

3.1.14 Calculating Text Regions

In order to flow text into arbitrary regions it is necessary to calculate what areas of the arbitrary region are available for text placement. SVG uses a fairly simple algorithm to do this.

In summary you intersect the flow region geometry with the current line-box. The result of this intersection is referred to as the strip. The strip is then split into text regions where ever a piece of geometry from the flow region 'intrudes'. It is important to ignore edges & points that are co-incident with the top or bottom of the line-box.

The diagram below shows the text strips used on a given shape.


Text Spans
Spans outside of flow region
Spans excluded because of geometry
Geometry Bounding Boxes
Strip bounds

The following is the algorithm with more detail:

The current flow region and any applicable exclude regions must be combined into one piece of geometry, simply concatenating the geometry is sufficient as this entire algorithm deals simply with segments of the paths and does not use directionality information until the inclusion tests at the end. The result of the concatenation of the geometry is referred to as the flow geometry.

Next the line-box is calculated, from the top/right edge of the line, the line-height and the bounding box of the flow region. This line-box is intersection with the flow geometry, clipping the flow geometry segments to the line box.

The bounding box is then calculated separately for each of the segments in the intersection.

The left and right (top and bottom respectively for vertical text) edges of the bounding boxes are sorted in increasing coordinate order (x for horizontal text, y for vertical text), for edges at the same location the left/top (or opening) edge is considered less than right/bottom (or closing) edges. The following pseudo code then generates the list of open areas for the current line:

```
Edge [] segs = ...; // The sorted list of edges.

Edge edge = segs[0];
int count = 1;
double start = 0;
for (i=1; i<segs.length; i++) {
    edge = segs[i];
    if (edge.open) {
      // 'open' is true, this is the start of a block out region.
        if (count == 0) {
            // End of an open region so record it.
            rgns.add(new TextRegion(start, edge.loc));
        }
        count++;
    } else {
      // 'open' is false, this edge is the end of a block out region.
        count--;
        if (count == 0) {
            // start of an open area remember it.
            start = edge.loc;
        }
    }
}
```

This gives the regions of the strip that are unobstructed by any flow geometry (from either exclusion or flow regions), however those regions may be outside the flow region (such as in a hole, such as the middle of an 'O'), or inside an exclusion region. Thus the center of each rectangle should be checked first to see if it lies inside any exclusion region if so the rectangle is removed from the list. Second it must be checked for inclusion in the flow region, if it is inside the flow region then the rectangle is available for text placement and becomes a text region for the current strip.

Once all the text regions for a strip are located left and right Margins for horizontal text (top and bottom margins for vertical) as well as indent are applied. Margins are applied to each text region. For the first span in a paragraph (flowPara for flowRegionBreak) the indent is added to the appropriate margin of the first text region. For left to right text this is the left margin of the left most text region, for right to left text this is the right margin of the right most text region, and for vertical text is the top margin of the top most text region.

this is applying margins to every Text Region we could just apply them to the first/last text regions. Perhaps have a separate property for 'internal' margins and the 'external' margins?.

If the left/right (top/bottom) edges of a text region pass each other due to the application of margins (or indent) the text region is removed from the list. If the text region removed had indent applied the indent is not applied to the next text region in text progression direction it is simply ignored.

We could have the indent move but it isn't clear that this would always be correct. The above is simpler and for the cases where indent is most commonly used, simple rectangles, it doesn't matter.

Should we restrict indent's range such that it can be no more negative than the margin it is applied to? Our feeling is no. If the user wants to shift the boxes out they should be able to - the only complication this adds is that the geometry may no longer define the bounding box of the text.

Flowing text using system fonts is a difficult operation. Content developers should not expect reproducible results between implementations. The most likely scenario for a reproducible result, although still not completely guaranteed, will be achieved by using SVG Fonts.

3.1.15 Alignment

Horizontal alignment in flowing text is provided by the text-align property. It is a modified version of the CSS3 property.

text-align

Value:	start | end | before | after | center | justify
Initial:	start
Applies to:	flowText, flowPara, flowDiv elements
Inherited:	yes
Percentages:	N/A
Media:	visual
Animatable:	yes

For details refer to the CSS3 Text Module. Note that SVG does not allow the value "string" for this property, and that the values "left" and "right" have been replaced by the internationalized equivalents, "before" and "after".

Vertical alignment in flowing text is provided by the vertical-align property from CSS2.

vertical-align

Value:	baseline | sub | super | top | text-top | middle | bottom | text-bottom | percentage | length | inherit
Initial:	baseline
Applies to:	text and flowText
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

For details refer to the CSS2 specification.

As currently specified, the vertical-align property is unsatisfactory for vertical text. The SVG Working Group requests feedback on this topic.

Vertical alignment will also be available on normal text elements.

3.1.16 Overflow

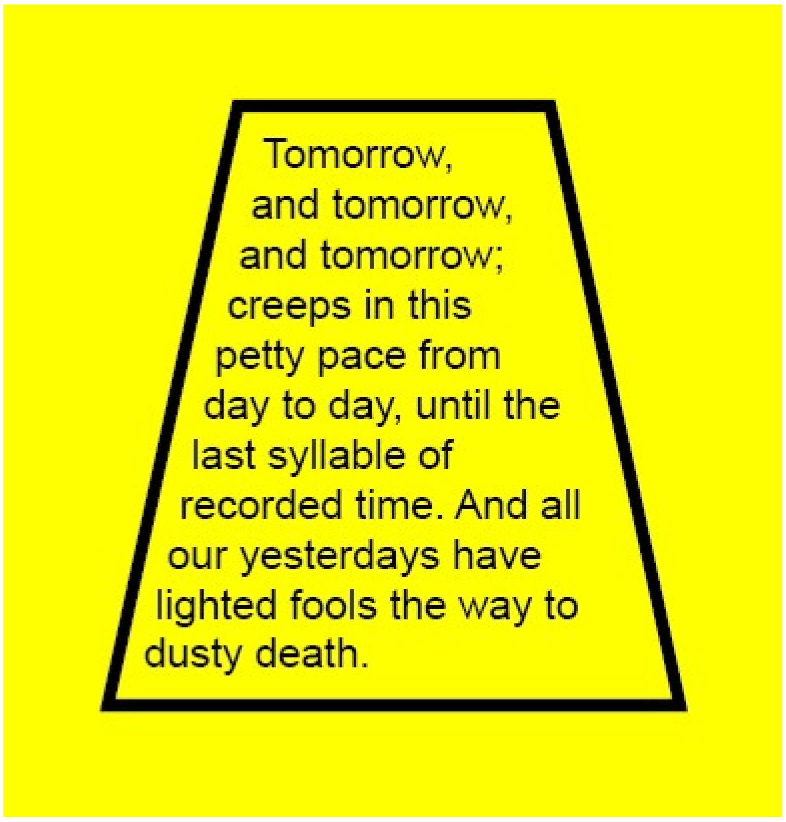
In the situations where the text and graphics associated with a flow do not fit into the defined regions an OverflowEvent is raised. The OverflowEvent contains information on the amount of text and graphics that could not be placed into the region.

The next draft of this specification will fully specify the behaviour of overflow.

3.1.17 Example

Below is an example of the flowing text capabilities:

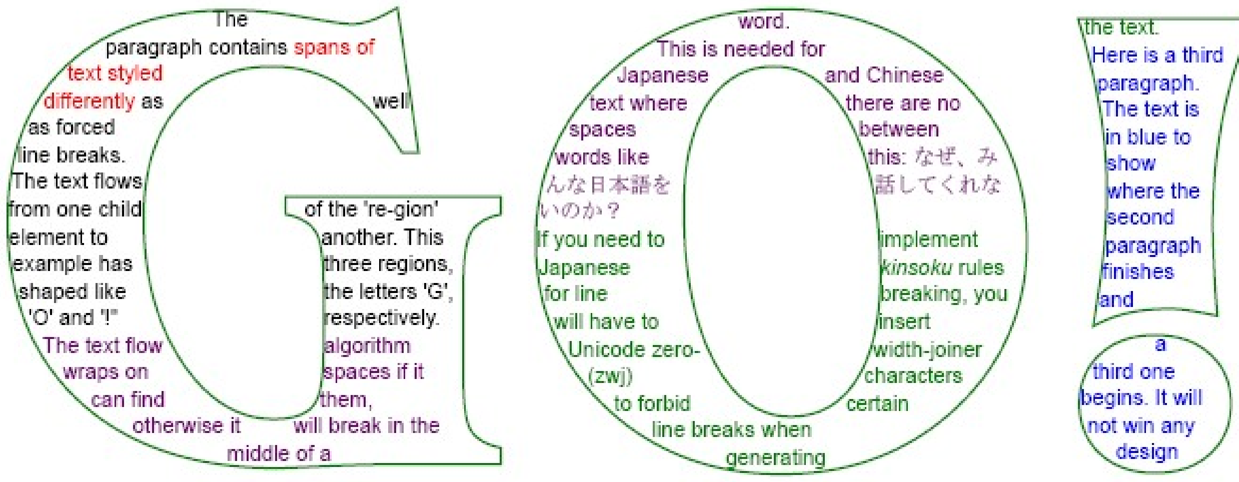
```
<svg xmlns:svg="http://www.w3.org/2000/svg" version="1.2"
     xmlns:xlink="http://www.w3.org/1999/xlink"
  width="100%" height="100%" viewBox="0 0 300 310">
  <title>Basic textflow</title>
  <rect x="0" y="0" width="100%" height="100%" fill="yellow"/>
  <flow font-size="16">
    <flowRegion>
      <path d="M100,50L50,300L250,300L300,50z"/>
    </flowRegion>
    <flowDiv>
      <flowPara>Tomorrow, and tomorrow, and tomorrow; creeps in this
       petty pace from day to day, until the last syllable of recorded time.
       And all our yesterdays have lighted fools the way to dusty death.
     </flowPara>
    </flowDiv>
  </flow>
  <path d="M90,40L40,270L260,270L210,40z" fill="none" stroke="black" stroke-width="5"/>
</svg>
```



Tomorrow,
and tomorrow,
and tomorrow;
creeps in this
petty pace from
day to day, until the
last syllable of
recorded time. And all
our yesterdays have
lighted fools the way to
dusty death.

[View this image as SVG (SVG-enabled browsers only)]

A more complicated example is show below. It is not included inline. Please see the SVG file for the source.



The
paragraph contains spans of
text styled
differently as
as forced
line breaks.
The text flows
from one child
element to
example has
shaped like
'O' and '!'"
The text flow
wraps on
can find
otherwise it
middle of a
well
of the 're-gion'
another. This
three regions,
the letters 'G',
respectively.
algorithm
spaces if it
them,
will break in the
word.
This is needed for
Japanese
text where
spaces
words like
んな日本語を
いのか？
If you need to
Japanese
for line
will have to
Unicode zero-
(zwj)
to forbid
line breaks when
generating
and Chinese
there are no
between
this: なぜ、み
話してくれな
implement
kinsoku rules
breaking, you
insert
width-joiner
characters
certain
the text.
Here is a third
paragraph.
The text is
in blue to
show
where the
second
paragraph
finishes
and
a
third one
begins. It will
not win any
design

[View this image as SVG (SVG-enabled browsers only)]

3.2 Editable Text Fields

There are many SVG use cases where textual input is a requirement. Implementing such a feature in SVG 1.1 with the DOM is nearly impossible without restricting functionality, such as only allowing latin left-to-right text.

SVG 1.2 introduces editable text fields, moving the burden of text input and editing to the user agent, which has access to system text libraries.

3.2.1 The editable attribute

The text and flowDiv elements have an editable attribute which defines if the contents of the elements can be edited in place.

editable = "true" | "false"

> If set to "false" the contents of the text element are not editable in place through the user agent. If set to "true", the user agent must provide a way for the user to edit the content of the text element and all contained subelements which are not hidden (with visibility="hidden") or disabled (through the switch element or display="none"). The user agent must also provide a way to cut the selected text from the element and to paste text from the clipboard into the element. If no value is given for this attribute, the default value is "false". Animatable: Yes.

In general, user agents should allow for the inline WYSIWYG editing of text with a caret that identifies current position. They should also support system functions such as copy/paste and drag/drop if available.

For WYSIWYG editing the following functionality must be made available:

- movement to the next/previous character (in logical order) with Left/Right arrows for horizontal text and Down/Up keys for vertical text
- movement to the next/previous line with the Down/Up keys for horizontal text and Right/Left for vertical text
- movement to the beginning of the line with the Home key
- movement to the end of the line with the End key
- the system-dependent keyboard binding for copy/cut/paste

For devices without keyboard access, the equivalent system input methods should be used wherever possible to provide the functionality described above.

The content of the DOM nodes that are being edited should be live at all times and reflect the current state of the edited string as it being edited (except for the state associated with an Input Method Editor window).

3.2.2 CSS pseudo class for editable text

To match the two states of editable text and flowText elements, SVG user agents that suppport CSS style sheets must support the ':edited' pseudo-class. It is used to style the currently editable text field. As such, it is equivalent to the following CSS selectors:

```
   svg|text[editable='true']:focus
   svg|flowText[editable='true']:focus
```

3.3 Text Selection

The SVGSelection interface allows the user to obtain details on the current text selection. When the user selects some text in a text or flowRoot element, the SVGSelectionEvent event is dispatched to the top-level svg element.

```
interface SVGSelection
{
  readonly attribute boolean       active; // true if something is selected
  readonly attribute string        text;
  readonly attribute dom::Element  firstElement;
  readonly attribute SVGElementInstance   firstElementInstance;

  // index in characer data for the first selected character
  readonly attribute unsigned long firstIndex;

  // index in character data for the first non-selected character
  readonly attribute unsigned long lastIndex;

  readonly attribute dom::Element         lastElement;
  readonly attribute SVGElementInstance   lastElementInstance;
};

interface SVGSVGElement
{
        ....
        readonly attribute SVGSelection selection;
};

// sent to the top-level svg element when selection changes in any way
interface SVGSelectionEvent : events::Event
{
};
```

The SVGSelectionEvent is named "SVGSelectionChanged".

4 Rendering Custom Content

SVG 1.2 adds the ability to associate behavior or extensions with arbitrary XML markup within an SVG file. This feature is referred to as Rendering Custom Content (RCC).

The RCC feature set is expected to be moved to a separate specification from the next publication of this document. Discussions are already under way to merge the functionality with the XML Binding Language (XBL) that has been implemented in some HTML browsers. This will not delay the SVG 1.2 specification, and will allow the features to be used in multiple document formats (including both SVG and XHTML). A new XBL specification is being developed by the SVG Working Group with liaison with other W3C Working Groups. It is highly likely that the first official W3C version of XBL will address the requirements of SVG 1.2, where future versions add some features needed by other document languages.

4.1 Element definitions

4.1.1 The extensionDefs element

The extensionDefs element registers a set of custom elements, all of which are in the same namespace.

The extensionsDefs element can be used in either of two ways. First, the custom elements can be defined within the content of the extensionDefs element, most significantly via elementDef child elements. Here is an example which defines two custom elements, equilateral-triangle and rhombus, in the "http://example.org" namespace:

```
<extensionDefs namespace="http://example.org">
  <elementDef name="equilateral-triangle">...</elementDef>
  <elementDef name="rhombus">...</elementDef>
</extensionDefs>
```

Alternatively, the extensionDefs element can include an xlink:href attribute (i.e., an href attribute in the

XLink namespace) which specifies an XPointer value to a different extensionDefs element, most often located in a different file or resource.

Here is a snippet from the SVG file which will get displayed:

```
<extensionDefs xlink:href="http://example.org/cool/cool.svg#CoolExtensions"/>
<g xmlns:cool="http://example.org/cool">
  <cool:bellbottoms x="20" y="60" width="40" height="200"/>
  <cool:leisuresuit x="80" y="60" width="40" height="200"/>
</g>
```

Here is a snippet from the referenced SVG file which defines the extensions:

```
<extensionDefs id="CoolExtensions" namespace="http://example.org/cool">
  <elementDef name="bellbottoms">...</elementDef>
  <elementDef name="leisuresuit">...</elementDef>
</extensionDefs>
```

The following is a schema snippet which defines the extensionDefs element:

```
<xs:element name='extensionDefs'>
  <xs:complexType>
    <xs:choice minOccurs='0' maxOccurs='unbounded'>
      <xs:element ref='elementDef'/>
      <xs:element ref='defs'/>
      <xs:element ref='script'/>
    </xs:choice>
    <xs:attributeGroup ref='PresentationAttrs'/>
    <xs:attributeGroup ref='StyleAttrs'/>
    <xs:attribute ref='xlink:href'/>
    <xs:attribute name='namespace' type='anyURI'/>
  </xs:complexType>
</xs:element>
```

The above schema may need to be modified to constrain the grammar such that there can be either an xlink:href attribute which points to the real definition of the extensions (probably in a separate file) or a combination of namespace attribute and content, which would be required if xlink:href is not present.

Attributes:

xlink:href:
: XPointer to another extension, possibly in a different file. If an xlink:href is specified, then it must reference a different extensionDefs element and that extensionDefs element itself must not have an xlink:href attribute; otherwise, the element is in error. If an xlink:href is specified, then certain other attributes (e.g., namespace) and child elements (e.g., elementDef element must not be present; otherwise, the element is in error. (Note: include hyperlink to Error Handling appendix).

namespace:
: Namespace URI for the elements defined in the extension. If the namespace attribute is present, the extensionDefs must not have an xlink:href attribute.

4.1.2 The elementDef element

The elementDef element is used to define a custom element. It encapsulates all information about the element. Also, all event listeners for this element are implicitly attached to the custom elements that it defines. That makes it convenient to put handler elements with XMLEvent ev:type attribute as its children or use event attributes (e.g., onactivate or onmousemove).

The most essential function of the elementDef element is to control the definition of the shadow tree for the given custom element. The shadow tree is built from automatic cloning of the contents of the prototype child element or copying the tree generated by the XML transformer referenced by the transformer element, as well as DOM manipulation of the shadow tree via scripting.

The shadow tree can include instances of other custom elements, in which case elementDef processing happens recursively.

The following is a schema snippet which defines the elementDef element:

```
<xs:element name="elementDef">
  <xs:complexType>
    <xs:choice  minOccurs="0" maxOccurs="unbounded">
      <!-- xsd:group ref="svg:desc-title-metadata"/>
      <xs:element ref="defs"/>
      <xs:choice minOccurs="0" maxOccurs="1">
        <xs:element ref="prototype"/>
        <xs:element ref="traitDef"/>
        <xs:element ref="transformer"/>
      </xs:choice>
      <xs:element ref="script"/>
    </xs:choice>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
    <xs:attribute name="name" type="NCName" use="required" />
    <!-- anything else??? -->
  </xs:complexType>
</xs:element>
```

The name attribute specifies the name of the element being defined.

The above schema may need to be modified to constrain the grammar so that only one prototype or transformer element can be specified.

An attribute which prevents initial shadow tree generation may be added to the elementDef element.

4.1.3 The defs element

This is the standard SVG defs element. Its purpose as a child of elementDef is to be a container for the various resource elements that might be referenced by other elements within the elementDef. The defs is most commonly used to define referenced objects such gradients, filters or symbols, but there are no restrictions for the contents with the defs.

4.1.4 The prototype element

This element is used to define an initial shadow tree for the custom element defined by its parent. The contents of the prototype element are copied onto the 'shadowTree' DOM property for the custom element.

The prototype element is optional. If not present, there is no automatic cloning into the shadow tree. However, even without a prototype element, the shadow tree can still contain contents due to the possibility of DOM manipulation via other means such as scripting.

Because shadow trees can contain instances of other custom elements, it is allowed that a prototype element contains other custom elements.

4.1.5 The transformer element

The transformer element is likely to be removed from the next draft of SVG 1.2, due to the high burden on implementation and the difficulty in optimization.

An XML transformer is something that takes XML as input, and produces XML as output, like an XSLT stylesheet. The transformerelement provides the ability to run a specified XML transformer with specified parameter values, and place the results onto the 'shadowTree' DOM property for the custom element. It is equivalent to the output of the transformation being placed as the literal content of a prototype element. In particular, if the XML transformer's output includes refContent or custom element output, then further shadow tree references are implicit in the output, just as they would be within a prototype element.

Suppose an elementDef is defined for a custom element, and that elementDef has a transformer child. If the custom element has an svg:input attribute (where the 'svg:' prefix is bound to the SVG namespace), then the input for the XML transformer is the XML tree specified by the svg:input attribute value, which is a URI. For example, this URI can point to:

1. an external XML resource
2. an element within an external XML resource, in which case the sub-tree rooted at that element is used
3. an element within the same SVG resource, which we interpret in terms of the current state of the SVG DOM, in which case the sub-DOM rooted at the referenced element node is used

If the custom element does not have an svg:input attribute then it behaves as if the svg:input attribute has a default value pointing to the custom element in question, meaning that the input for the XML transformer is the branch of the DOM rooted at this custom element.

When a custom element's shadow tree includes a refContent element, this refers to the shadow trees of the descendants of the custom element in question, regardless of whether the shadow tree was generated by a transformer element and regardless of whether the custom element has an svg:input attribute pointing elsewhere. The refContent mechanism is not used to recurse on the XML trees of external resources.

The transformation code specified by the transformer element is run on document load and every time there is a mutation anywhere in the document.

This idea of running a script or other process on a branch of an XML tree to produce a generated SVG sub-tree is not specific to XSLT, so it should be possible, in theory, to specify the MIME type of the script file to be something else like XQuery, Java, or ECMAScript. Initially, we'll only deal with XSLT as the default and as top priority for implementers.

There is discussion of using an element like in or source rather than an attribute to provide the functionality of the svg:input attribute.

An attribute which prevents the svg:input from being usable with a particular custom element may added to the elementDef element.

The example below demonstrates a trivial use of the transformer element that draws red diamonds.

```
<svg width="10cm" height="3cm" viewBox="0 0 100 30" version="1.2"
     xmlns="http://www.w3.org/2000/svg" xmlns:xlink="http://www.w3.org/1999/xlink">

  <extensionDefs id="shapes" namespace="http://foo.example.org/shapes">

    <xsl:stylesheet id="diamond" version="1.1"
     xmlns="http://www.w3.org/2000/svg"
```

```
      xmlns:foo="http://foo.example.org/shapes"
      xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

      <xsl:template match="foo:diamond">

       <svg x="{@x}" y="{@y}" width="{@width}" height="{@height}"
               viewBox="0 0 100 100">
         <rect transform="rotate(44,50%,50%)"
          fill="red"
          width="100%"
          height="100%"/>
       </svg>

      </xsl:template>

     </xsl:stylesheet>


   <elementDef name="diamond">
     <transformer xlink:href="#diamond" type="text/xsl"/>
   <elementDef>

  </extensionDefs>


  <foo:diamond x="10" y="10" width="30" height="30"/>
  <foo:diamond x="50" y="15" width="25" height="25"/>
  <foo:diamond x="5" y="20" width="25" height="10"/>

</svg>
```

The following is a schema snippet which defines the transformer element:

```
<element name="transformer">
   <complexType>
     <choice minOccurs="0" maxOccurs="unbounded">
       <element ref="svg:param"/>
       <!-- <group ref="svg:desc-title-metadata"/> -->
     </choice>
     <attribute ref="xlink:href" use="required"/>
     <attribute name="type" type="string"/>
   </complexType>
</element>
```

Attributes:

xlink:href = " uri"
: A URI reference to an XML transformer, such as an XSLT stylesheet. Animatable : no.

type = "content-type"
: Identifies the XML transformer language for the given 'transformer' element. The value content-type specifies a media type, per [RFC2045]. Animatable : no.

Mechanics for XSLT, which is the initial focus, are clear. URI syntax and invocation mechanics may also be added for Java and ECMAScript.

4.1.6 The param element

The param element passes string information to the XML transformer (such as XSLT), mimicking the information that could be passed on the command line to the XML transformer.

The name of the param element is not finalized. Other candidate names include with-param and withParam.

The example below demonstrates a trivial use of the param element.

```
<svg width="7cm" height="5cm" viewBox="0 0 70 50" version="1.2"
     xmlns="http://www.w3.org/2000/svg" xmlns:xlink="http://www.w3.org/1999/xlink">

  <extensionDefs id="shapes" namespace="http://foo.example.org/shapes">

    <xsl:stylesheet id="light" version="1.1"
     xmlns="http://www.w3.org/2000/svg"
     xmlns:foo="http://foo.example.org/shapes"
     xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

     <xsl:param name="lightcolor">

     <xsl:template match="foo:description">
         <!-- Strip out descriptions -->
     </xsl:template>

     <xsl:template match="foo:light">

      <xsl:variable name="x" select="../@x" />
      <xsl:variable name="y" select="../@y" />
      <xsl:variable name="width" select="../@width" />
      <xsl:variable name="height" select="../@height" />

      <svg x="{$x}" y="{$y}" width="{$width}" height="{$height}"
              viewBox="0 0 100 100">

        <rect transform="rotate(44,50%,50%)"
         stroke="black"
         stroke-width="1"
         width="100%"
         height="100%"/>

         <circle stroke="none" fill="{$lightcolor"}
         cx="50%"
         cy="50%"
         r="25%"/>

      </svg>

     </xsl:template>

    </xsl:stylesheet>


   <elementDef name="stop">
     <transformer xlink:href="#light" type="text/xsl">
       <param name="lightcolor" value="red"/>
     </transformer>
   <elementDef>

   <elementDef name="go">
     <transformer xlink:href="#light" type="text/xsl">
       <param name="lightcolor" value="green"/>
     </transformer>
   <elementDef>

   <elementDef name="gofast">
     <transformer xlink:href="#light" type="text/xsl">
       <param name="lightcolor" value="yellow"/>
     </transformer>
   <elementDef>

  </extensionDefs>


  <foo:stop x="10" y="10" width="30" height="30" >
    <foo:description>A "stop" with a light</foo:description>
    <foo:light/>
  </foo:stop>

  <foo:gofast x="50" y="15" width="25" height="25" >
    <foo:description>A "gofast" with a light</foo:description>
    <foo:light/>
  </foo:gofast>

  <foo:go x="5" y="20" width="25" height="10" >
    <foo:description>A "go" with a light</foo:description>
    <foo:light/>
  </foo:go>

</svg>
```

The following is a schema snippet which defines the param element:

```
<element name="param">
   <complexType>
     <attribute name="name" type="NMTOKEN" />
     <attribute name="value" type="string" use="required"/>
   </complexType>
</element>
```

Attribute definitions:

value = string"
: The string value of the parameter for the XML transformer. Animatable : no.

name = string"
: The name of the parameter for the XML transformer, if the XML transformer (like XSLT) has named parameters/flags. Animatable : no.

The param element binding with XSLT is fairly clear. The binding for Java and perhaps also ECMAScript needs to be specified.

4.1.7 The refContent element

The refContent element is often an essential feature when the content developer requires a custom container element. One example of a custom container element is a custom scrollArea element where the contents should render normally except with customized translations and clipping due the special container element behavior.

With refContent, the contents of the container do not get cloned into the shadow DOM; instead, the shadow DOM refers back into the custom element's DOM (the original DOM) for some of the graphics to be rendered. In addition to allowing an effective subclassing of SVG's container elements such as g, refContent offers potential performance and memory-saving benefits by preventing duplication of the DOM when such duplication is unnecessary or undesirable.

The refContent element acts as a virtual grouping element within the shadow DOM for a set of referenced elements in the custom element's DOM. The effect in terms of rendering and behavior is as if the referenced elements had been moved into the shadow DOM temporarily in order to accomplish the necessary rendering operations and behaviors (e.g., hit testing).

Using the optional select attribute, refContent can specified a subset of the custom element's descendants.

It is legal to have multiple refContent elements in the shadow subtree, but the subsets of the children that they select must not intersect.

In the example below, a ui:scrollArea custom element establishes a scrollable region onto which any SVG content can be rendered:

```
<extensionDefs...>
  <elementDef name="scrollArea">
    <prototype>
      <svg ...>
        <refContent/>
      </svg>
      <!-- assume a scrollbar custom element is defined elsewhere -->
      <ui:scrollbar.../>
    </prototype>
    <!-- etc. -->
  </elementDef>
</extensionDefs>

<ui:scrollArea>
  <image .../>
  <path ... />
  <text...>...</...>
  <!-- etc. -->
</ui:scrollArea>
```

In the simple flowchart example provided earlier, the flowchart custom element itself is a container for other flowcharting custom elements such as processNode and terminalNode. The implementation of the flowchart custom element takes advantage of refContent to simply refer to the custom element's (i.e., the flowchart element's) original content (i.e., a list of processNode and terminalNode custom elements):

```
<extensionDefs...>
  <elementDef name="flowchart">
      <prototype><refContent/></prototype>
      <!-- etc. -->
  </elementDef>
</extensionDefs>

<flowchart xmlns="http://example.org/rcc-flowcharts"...>
  <terminalNode>Start</terminalNode>
  <processNode>Step 1</processNode>
  <processNode>Step 2</processNode>
  <terminalNode>End</terminalNode>
</flowchart>
```

The refContent element is defined as follows:

```
<xs:element name="refContent">
  <xs:complexType>
    <xs:sequence>
      <!-- xsd:group ref="svg:desc-title-metadata" minOccurs="0" maxOccurs="unbounded"/>
      <xs:attributeGroup ref="PresentationAttrs"/>
      <xs:attributeGroup ref="StyleAttrs"/>
      <xs:attribute name="select" type="???" use="optional" />
      <xs:attribute name="transform" type="???" use="optional" />
      <!-- event attributes??? overflow/clip??? -->
      <!-- anything else??? -->
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

The select attribute defines an XPath selector for the node set that should be connected here. Only a small subset of XPath is allowed: "***", "name", "***[#]", "name[#]" where name is any identifier and # is a number

4.2 The traitDef element

A trait is a potentially animatable parameter associated with an element. A trait is the value that gets assigned through an XML attribute or CSS style or SMIL animation. In the case of RCC, it describes an attribute on a custom element, allowing it to be exposed to the animation engine.

Traits for custom elements are described using the traitDef element.

```
<xs:element name="traitDef">
  <xs:complexType>
    <xs:sequence>
      <xs:attribute name="name" use="required" />
      <xs:attribute name="namespace" use="required" />
      <xs:attribute name="type" use="required" />
      <xs:attribute name="valueType" use="required" />
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

The name and namespace attributes respectively specify the name and namespace of the attribute.

The type attribute is similar to the corresponding type attribute from animation elements. It allows the values "CSS" and "XML". The default is "XML".

The valueType attribute specifies the type of the attribute. It only supports existing values, such as "SVGMatrix", "SVGLength", etc.

Need to define exact list of valueTypes.

Below is an example that defines traits for the x, y, width and height attributes for a custom foo:button element.

```
<elementDef name="button" namespace="http://www.example.com/foo">
        <traitDef name="x" valueType="SVGLength"/>
        <traitDef name="y" valueType="SVGLength"/>
        <traitDef name="width" valueType="SVGLength"/>
        <traitDef name="height" valueType="SVGLength"/>
        <prototype>
                ....
        </prototype>
</elementDef>
```

4.2.1 Shadow Tree Generation

Shadow tree generation occurs initially when the document is loaded. Shadow tree generation also occurs when a custom element is added to the SVG document via DOM.

Subsequent regeneration of shadow tree for particular elements may be triggered by a declaratively specified set of events.

Declarative syntax for specifying the set of events that cause a particular element's shadow tree to be regenerated hasn't yet been developed. It may be a SMIL like list of events (the "begin" and "end" animation timing attributes can take an event list) or use some sort of XML event listener syntax.

The default (perhaps empty) set of events that cause shadow tree regeneration is to be determined.

In addition an attribute may be set that causes the UA to regenerate shadow trees every time there is a modification to the DOM that may affect the shadow tree.

Declarative syntax for specifying the above attribute hasn't yet been developed. It's default value is to be determined. In addition, what "a modification to the DOM that may affect the shadow tree" means needs to be tightly specified.

In addition, there is a DOM call "rebind()" that causes regeneration of the shadow tree for a particular element.

4.3 RCC support in the SVG DOM

On the DOM level, all custom elements have a shadowTree attribute that points to an SVGShadowElement.

If this attribute is null (which it normally is), then an element "behaves normally". For example, normal behavior for foreign namespace elements is that they don't get rendered. However, if this attribute is not null, all rendering and interactive behavior is determined by the content of this attribute. This affects all behavioral aspects of the element (rendering, hit testing, layout, UI events etc.), but not its "DOM" aspects (Core DOM calls, document events, mutation events, etc.)

The node which is attached to an element through an 'shadowTree' DOM property is said to belong to the "Shadow DOM". It remains a normal Node in all respects, though. A Node can be attached only to one element at a time and it must not have a parentNode. From the Core DOM point of view, it is not attached to the document tree (which is perfectly legal). It is legal for a Node owned by one document to be attached to the element from another document as well. And it is also legal for the "Shadow DOM" Nodes to have their own "shadow" subtrees attached (through their nested own 'shadowTree' DOM properties).

The SVG DOM should provide a method to set the 'shadowTree' of an element. With such a method, RCC DOM can be used even without an associated syntax. Also there should be a method to obtain an element given its shadow DOM root. Here is an initial proposal, which introduces new interfaces SVGShadowElement and SVGShadowable:

```
interface SVGShadowElement : Element {

   Element getShadowOwnerElement() raises ... ;
   void rebind() raises ... ;
}

interface SVGShadowable {

  readonly attribute SVGShadow Element shadowTree ;

  void setShadowTree (in SVGShadow Element newShadow) raises ...;
}
```

All unknown elements (generally, all elements in a different namespace) implement interface SVGShadowable.

4.4 RCC Events

Two new events are defined to support the RCC feature set: SVGBindBegin and SVGBindEnd. SVGBindBegin is fired before the user agent creates the shadow tree for a custom element. SVGBindEnd is fired when the user agent has finished adding the element's shadow tree to the element and after any custom elements in the shadow tree have been processed.

Initial processing of custom elements is done in document order (preorder depth first traversal of the tree). This means that initially, a custom element's SVGBindBegin must be fired before the element's descendants shadow trees have been created and therefore before any of the descendants' SVGBindBegin and SVGBindEnd events have been fired. For progressive rendering, a custom element's SVGBindBegin may not be fired until the custom element's end tag has been read.

Regeneration of a custom element's shadow tree causes SVGBindBegin and SVGBindEnd events to be fired.

The two new event types extend dom::Event. The event target is the custom element.

4.5 Implementation Notes

In order to ensure interoperability:

- SVG Generators which create content using RCC must ensure that all RCC-defined custom elements have definitions (via extensionDefs elements and their descendants) which can be accessed via normal Web URI referencing
- SVG user agents must process the custom elements as specified in the extensionDefs and not implement unique proprietary rendering or behavior (exceptions: when the extensionDefs is properly bracketed with switch and appropriate requiredExtensions attributes or when the custom element definition explicitly allows user agent optimization of particular aspects of rendering and/or behavior).

Any script elements inside of extensionDefs elements get evaluated once at the time the script elements contents have been added to the DOM tree. (The result of evaluation often adds function definitions to the scripting environment, and these function are available indefinitely.) Any handler elements inside of extensionDefs elements which have an ev:event attribute get evaluated every time the given event occurs, similar to how event attributes such as onclick get re-evaluated every time the user clicks on the given element.

Circular references within the definitions of custom elements must raise an error. The shadow tree for a custom element must not contain the same custom element directly or indirectly. An example of illegal indirection would be where custom element A includes an instance of custom element B, which is OK, but then custom element B in turn includes an instance of custom element A, which is an indirect circular reference and must raise an error.

4.6 Open Issues

Here are some of the open issues that have been raised regarding potential RCC features that allow for transformation of semantically rich arbitrary XML into presentation-rich alternative SVG.

1. Where does the Alternative Generated SVG go? Does the generated SVG become part of the real DOM (which means the generated SVG could be reached via firstChild, nextSibling, etc. off of the main document tree) or does the generated SVG go into some sort of shadow DOM (which means the generated nodes can be reached, but not via firstChild, nextSibling, etc. on the main document tree).

Some of the arguments in favor of shadow trees are:

- SaveAs should only show original data, not result of styling
- Philosophical: Rendering tree is a transient thing that should not be part of real DOM
- Scripts get messed up by modifying real DOM (new elements appear in the wrong place)
- Philosophical: Requirement of clean separation of model versus view
- Philosophical: Implementers need freedom of released storage for purge/regenerate of rendering tree

Some of the arguments against shadow trees:

- How to style versus CSS selectors
- Potential implementation and specification complexity

Resolution: alternate generated SVG goes onto a shadow tree in the form of a DOM attribute off of the custom element.

2. What events trigger a recalculation operation from Original XML into Alternate SVG? One candidate is that by default regeneration is triggered by DOM Mutation events.

   Resolution: regeneration of shadow tree is triggered via event handling/listener which is manually established using XML event listeners.

3. How does XML Events relate to this feature?

   Resolution: the feature will use XML events for event handling.

4. Is the primary use case "skinning" XForms, more general UI widgets, or defining a way of presenting (SVG) views of arbitrary XML data? (This issue is discussed in more detailed under Possible Approaches above.)

   Resolution: the current approach seems to cover most situations in both cases.

5. Is a kind of use that leverages XForm's instance model, or is it a new templating language?

   Resolution: the working group is still working on the relationship of the arbitrary XML features in RCC with the arbitrary XML features in XForms. There is an example earlier which shows how XForms might work with RCC. Certainly, there are templating aspects to RCC, but it more like an extensibility mechanism that maps XML namespaces into presentation+behavior than just a templating facility.

6. Should the mapping be one way or two way (ie. should there be a way to automatically reflect changes in the transformed content when the transformation is updated?)

   The working group is still working on this aspect of the feature.

7. Bidirectionality, particularly event mapping, almost certainly will require custom scripting in some circumstances. How far should RCC go in trying to minimize the number of situations where scripting is required?

   The working group is still working on this aspect of the feature. We'll know more after users try out the feature and send in their reports.

8. Dependency mapping (i.e., which fragments of Original XML relate to which fragments of Generated

SVG) is highly desirable but also will likely require custom scripting in some circumstances. How much leverage might RCC get from adopting XForms' approach to instance data? How feasible is it for implementations to do automatic dependency mapping? How far should RCC go in trying to define markup which explicitly defines dependencies?

The working group is still working on this aspect of the feature.

9. Should the feature be enabled by the styling system (ie. should you be able to apply a style rule that converts all myns:pie elements into a combination of svg:path elements?)

   The working group is still working on this aspect of the feature.

10. Is this an extension to the use element?

    Resolution: no, we aren't just going to add new options to the use element.

11. If a declarative syntax is used, SVG implementations may be required to support XPath and some simple XSLT features. Will the XSLT features be too much of an implementation burden?

    The working group is still working on this aspect of the feature.

12. What features are available in SVG Full vs SVG Basic vs SVG Tiny?

    Current thinking in the working group is that RCC is required in both Full and Basic. The working group is studying approaches where a subset of features could be made available in Tiny. The big problem with SVG 1.1 Tiny is that scripting is not part of Tiny, and the current design generally requires scripting support.

13. We might want a different name instead of "RCC", particularly because the feature goes beyond rendering.
14. Each document referenced through extensionDefs has its own script context?
15. Will it be possible to animate the attributes and properties within custom elements? There has been considerable discussion within the working group about extending RCC to allow for custom attributes and/or custom behaviors in addition to custom elements. One of the challenges with custom attributes is that XML defines the list of attributes on an element to be unordered. Also, there is no natural place to put a shadow tree onto an attribute. The working group is considering several different approaches, each of which has some positives and negatives. It is likely that a subsequent public draft will provide more clarity on this issue.
16. Do we want to define a shadowTree element? This could hold the flattened result of the recursive shadow tree on a custom element and would be useful in printing workflows, which may not have a scripting engine.
17. If RCC extension comes from a separate document, are shadow tree elements still owned by that document?

    Suggested resolution: no, shadow tree elements are owned by document with the custom element, not the document with the custom element's elementDefs

18. Subclassing elementDef - should there be mechanisms to facilitate subclassing of extensionDefs, where you use most of a different elementDef's look and behavior but override just one aspect?

    Suggested resolution: no.

19. Should elements in the SVG namespace be allowed to have shadow trees? Clearly, it is undesirable for

certain elements (e.g., extensionDefs, elementDef, prototype) to have shadow trees due to implementation recursion problems, so not all SVG elements could have shadow trees. A major consideration is forward and backward compatibility and what happens across different versions and profiles. Another consideration is the following language from the F.2 Error Processing section of the SVG 1.1 specification: "...an SVG document fragment is technically in error... when an element or attribute is encountered in the document which is not part of the SVG DTD and which is not properly identified as being part of another namespace... when an element has an attribute or property value which is not permissible according to this specification" . The current feeling within the SVG working group is that it is too hard to allow shadow trees on elements in the SVG namespace, but we are interested in hearing public comment on the desirability of this. If SVG elements can also have shadow trees (i.e., not just non-SVG elements), which gets rendered first - the SVG element or the shadow tree, or maybe should we have an attribute to control this?

20. We need to disallow all types of circular referencing. For example, prototype elements cannot reference the custom element which is being defined, itself, or anything within its content.
21. Do we want to disallow the SVG namespace URI within the 'namespace' attribute on extensionDefs?
22. Do we want to add an expression evaluation facility such as DOM3 XPath to the SVG DOM as a complementary feature to RCC to enable RCC to be used in application areas which require expression-based attribute values?

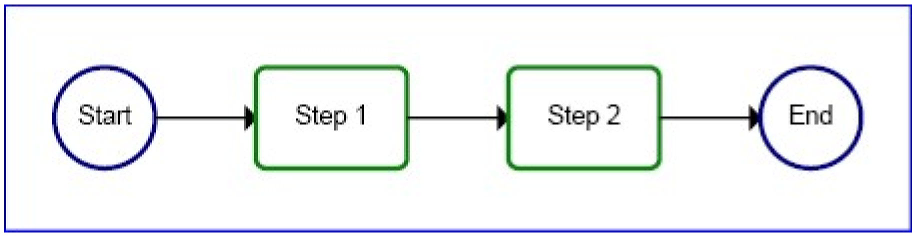
4.7 Examples of RCC

Below is a simple example of the Rendering Custom Content feature. In the example, the SVG file references a set of custom elements for flowcharting using the extensionDefs element, and then uses the custom elements to draw the flowchart. Note that the document below is semantically more meaningful due to the use of the custom elements than it would have been if the file had contained just the low-level visual presentation elements (i.e., circle, rect, path and text):

```
<svg width="12cm" height="3cm"
     xmlns="http://www.w3.org/2000/svg" version="1.2">
  <desc>Example rcc01 - simple flowchart example using RCC</desc>

  <!-- XPointer reference to the location for the flowchart extensions -->
  <extensionDefs xlink:href="rcc01-flowchart-exts.svg#flowcharts"/>

  <!-- Use the flowchart extensions. As a result of using the extensions,
       a shadow tree of low-level SVG (circle, rect, path elements)
       is added to the SVG DOM. The user agent renders the shadow tree. -->
  <flowchart xmlns="http://example.org/rcc-flowcharts"
             x="0%" y="0%" width="100%" height="100%">
    <terminalNode>Start</terminalNode>
    <processNode>Step 1</processNode>
    <processNode>Step 2</processNode>
    <terminalNode>End</terminalNode>
  </flowchart>
</svg>
```



View this image as SVG (SVG-enabled browsers only)

Here is the file which defines the simple flowcharting extensions used in the example above:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ev="http://www.w3.org/2001/xml-events">
  <desc>Supplemental file for example rcc01.svg -
        contains definition of simple flowchart extension elements.</desc>

  <extensionDefs id="flowcharts" namespace="http://example.org/rcc-flowcharts">

    <!-- Example needs to be upgraded to show handling of mutation events -->

    <defs>
      <symbol id="connectorline">
        <path transform="translate(0 50)" stroke="black" stroke-width="3" fill="black"
              d="M 0,0 L 90,0 L 90,-10 L 100,0 L 90,10 L 90,0"/>
      </symbol>
    </defs>

    <elementDef name="terminalNode">
      <prototype>
        <g>
          <circle stroke="#008" stroke-width="5"  fill="none" cx="50" cy="50" r="50"/>
          <text x="50" y="57" font-size="25" text-anchor="middle"><refContent/></text>
        </g>
      </prototype>
    </elementDef>

    <elementDef name="processNode">
      <prototype>
        <g>
          <rect stroke="#080" stroke-width="5" fill="none" width="150" height="100" rx="10",
          <text x="75" y="57" font-size="25" text-anchor="middle"><refContent/></text>
        </g>
      </prototype>
    </elementDef>

    <elementDef name="flowchart">
      <prototype>
        <svg><refContent/></svg>
      </prototype>
      <handler ev:event="SVGBindEnd" type="text/ecmascript"><![CDATA[
        var svgns = "http://www.w3.org/2000/svg";
        var xlinkns = "http://www.w3.org/1999/xlink";
        var flowchartns = "http://example.org/rcc-flowcharts";
        var ELEMENT_NODE = 1;
        var SIDE_INDENT = 50;
        var PROCESSNODE_WIDTH = 150;
        var TERMINALNODE_WIDTH = 100;
        var CONNECTOR_WIDTH = 100;
        var YPOS = 50;
        var flowchartelement = evt.target;
        var ap = flowchartelement.shadowTree;
        var svgElm = ap.firstChild;
        svgElm.setAttributeNS(null, "x", flowchartelement.getAttribute("x"));
        svgElm.setAttributeNS(null, "y", flowchartelement.getAttribute("y"));
        svgElm.setAttributeNS(null, "width", flowchartelement.getAttribute("width"));
        svgElm.setAttributeNS(null, "height", flowchartelement.getAttribute("height"));

        // Determine total width needed and set viewBox attribute appropriately.
        var totalWidth = 0;
        var nodeCount = 0;
        for( var node = flowchartelement.firstChild ; node != null ; node = node.nextSiblin
        {
          // only process elements in flowchart ns
          if( node.nodeType == ELEMENT_NODE && node.namespaceURI == flowchartns) {
            nodeCount++;
            if (node.localName == "processNode")
              totalWidth += PROCESSNODE_WIDTH;
            else if (node.localName == "terminalNode")
              totalWidth += TERMINALNODE_WIDTH;
          }
        }
        totalWidth += (nodeCount-1)*CONNECTOR_WIDTH + 2*SIDE_INDENT;
        svgElm.setAttributeNS(null, "viewBox", "0 0 "+totalWidth+" 200");
        var xtrans = 50;

        // Position all of the nodes and draw the connectors.
        var xpos = SIDE_INDENT;
        var nodeNum = 0;
        for( var node = flowchartelement.firstChild ; node != null ; node = node.nextSiblin
        {
          // only process elements in flowchart ns
          if( node.nodeType == ELEMENT_NODE && node.namespaceURI == flowchartns) {
            node.shadowTree.setAttributeNS(null, "transform", "translate("+xpos+" "+YPOS+")'
            var nodeWidth;
            if (node.localName == "processNode") {
              nodeWidth = PROCESSNODE_WIDTH;
            } else if (node.localName == "terminalNode") {
              nodeWidth = TERMINALNODE_WIDTH;
            }
            xpos += nodeWidth;
            // Add connector line to end of flowchart node's shadowTree.
            if (nodeNum < (nodeCount-1)) {
              var useElement = document.createElementNS(svgns, "use");
              useElement.setAttributeNS(xlinkns, "xlink:href", "#connectorline");
              useElement.setAttributeNS(null, "transform", "translate("+nodeWidth+" 0)");
              node.shadowTree.appendChild(useElement);
              xpos += CONNECTOR_WIDTH;
            }
            nodeNum++;
          }
        }
      ]]></handler>
    </elementDef>

  </extensionDefs>

</svg>
```

The next example takes sample code from section 4.6 from the Geography Markup Language (GML) specification, version 2.1.2. The 'extensionDefs' element would effect a client-side transformation from original XML/GML into final-form SVG rendering.

```
<svg width="12cm" height="3cm"
     xmlns="http://www.w3.org/2000/svg" version="1.2">
  <desc>Example rcc-gml-01 - GML and RCC</desc>

  <!-- XPointer reference to the location for the GML extensions -->
  <extensionDefs xlink:href="rcc-gml-01-exts.svg#gml"/>

  <CityModel xmlns="http://www.opengis.net/examples"
             xmlns:gml="http://www.opengis.net/gml"
             xmlns:xlink="http://www.w3.org/1999/xlink"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xsi:schemaLocation="http://www.opengis.net/examples city.xsd">

    <gml:name>Cambridge</gml:name>
    <gml:boundedBy>
      <gml:Box srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
```

```
        <gml:coord><gml:X>0.0</gml:X><gml:Y>0.0</gml:Y></gml:coord>
        <gml:coord><gml:X>100.0</gml:X><gml:Y>100.0</gml:Y></gml:coord>
      </gml:Box>
    </gml:boundedBy>

    <cityMember>
      <River>
        <gml:description>The river that runs through Cambridge.</gml:description>
        <gml:name>Cam</gml:name>
        <gml:centerLineOf>
          <gml:LineString srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
            <gml:coord><gml:X>0</gml:X><gml:Y>50</gml:Y></gml:coord>
            <gml:coord><gml:X>70</gml:X><gml:Y>60</gml:Y></gml:coord>
            <gml:coord><gml:X>100</gml:X><gml:Y>50</gml:Y></gml:coord>
          </gml:LineString>
        </gml:centerLineOf>
      </River>
    </cityMember>

    <dateCreated>2000-11</dateCreated>
  </CityModel>
</svg>
```

The next example takes sample code from [Appendix G of the XForms specification | http://www.w3.org/TR/xforms/sliceG.html] . The extensionDefs element would effect a client-side transformation from original XForms elements into final-form SVG rendering. In this example, the assumption is that the extension would implement all or at least a large part of the XForms specification via DOM/scripting.

```
<svg width="12cm" height="3cm"
     xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:xforms="http://www.w3.org/2002/xforms/cr"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema"
     xmlns:ev="http://www.w3.org/2001/xml-events"
     xmlns:my="http://commerce.example.com/payment">
  <desc>Example rcc-xforms-01 - using RCC within a combined XForms+SVG user agent</desc>
  <title xml:lang="fr">XForms en SVG</title>

  <!-- XPointer reference to the location for the XForms extensions to SVG.
       The extensions convert the XForms UI elements into low-level SVG
       interactive graphics and also provide  high-level features,
       such as client-side validation and the XForms event model. -->
  <extensionDefs xlink:href="rcc-xforms-01-exts.svg#xforms"/>

  <rx:renderXForms xmlns:rx="http://example.org/rcc-xforms"
         xmlns="http://www.w3.org/2002/xforms/cr">

    <model schema="payschema.xsd">
      <instance>
        <my:payment as="credit">
          <my:cc />
          <my:exp />
        </my:payment>
      </instance>
      <submission action="http://www.example.com/buy.rb" method="post" id="s00" />
      <bind nodeset="my:cc" relevant="../@as='credit'" required="true()" />
      <bind nodeset="my:exp" relevant="../@as='credit'" required="true()" />
    </model>

    <group xmlns="http://www.w3.org/2002/xforms/cr">
      <trigger>
        <label>Francais</label>
        <toggle case="fr" ev:event="xforms-activate" />
      </trigger>
      <trigger>
```

```
          <label>English</label>
          <toggle case="en" ev:event="xforms-activate" />
        </trigger>
      </group>

      <input ref="my:cc">
        <label xml:lang="fr">Numero de carte bancaire</label>
        <alert xml:lang="fr">Saississez un numro de carte bancaire en cours
          (sparez par un espace ou un trait d'union chaque groupe de chiffres)</alert>
      </input>

      <input ref="my:exp">
        <label xml:lang="fr">Date d'chance</label>
      </input>

      <submit submission="s00">
        <label xml:lang="fr">Achetez</label>
      </submit>
</svg>
```

The next example supplements the XForms example above with the following simple example which shows a set of extension elements ui:menubar, ui:menu, ui:menuitem) which present a menubar and a scrolling area for graphics.

```
<svg width="525" height="575"
     xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ui="http://example.org/rcc-ui">
  <desc>Example rcc-ui-01 - using rcc for UI elements</desc>
  <title>UI in SVG</title>

  <!-- XPointer reference to the location for the UI extensions to SVG.
       The extensions convert the UI elements into low-level SVG. -->
  <extensionDefs xlink:href="rcc-ui-01-exts.svg#ui"/>

  <ui:menubar x="25" y="25" width="500" height="20" font-size="14">
    <ui:menu title=File>
      <ui:menuitem title=New op="newdoc(evt)">
      <ui:menuitem title=Open op="opendoc(evt)">
    </ui:menu>
    <ui:menu title=Edit>
      <ui:menuitem title=Copy op="copy(evt)">
      <ui:menuitem title=Past op="paste(evt)">
    </ui:menu>
  </ui:menubar>

  <ui:scrollArea x="25" y="50" width="500" height="400">
    <image xlink:href="..." ... />
    <path d="..." ... />
    <text transform="..." font-size="...">...</text>
  </ui:scrollArea>
</svg>
```

The last example shows RCC being used for custom container elements that perform layout, in this case a magazine layout.

```
<svg>
  ...

  <!-- XPointer reference to the location for the widgets extensions to SVG.
       The extensions convert the widget elements into low-level SVG. -->
  <extensionDefs xlink:href="rcc-dynlayout-01-exts.svg#dynlayout" />

  <foo:DynamicPageLayout>
```

```
    <foo:articles>
      <foo:article>
        <foo:title>Major war erupts</foo:title>
        <foo:para>War broke out around the world today...</foo:para>
      </foo:article>
      <foo:article>
        <foo:title>Two headed-chicken born</foo:title>
        <foo:para>The sleepy town of Frostbite Falls is excited about...</foo:para>
      </foo:article>
    </foo:articles>
  </foo:DynamicPageLayout>
  ...
</svg>
```

5 Enhancements for Application development

5.1 XForms and SVG

XForms is a technology for describing forms in XML. It separates the model, or the information that is to be sent as the result of the form, from the abstract controls that will be used to get information from the person using the form. XForms deliberately says nothing about presentation of form controls; this is left to a styling or transformation language, to generate the actual visual (or indeed, audio) form widgets. XForms cannot be used by itself; it is designed to be integrated into a host language, such as SVG. This provides the host language with an abstract definition of form content and leaves the rendering to the host. SVG is well suited to hosting XForms, since it provides powerful rendering and interactivity APIs.

Furthermore, a generic set of user interface components has been a common request from the SVG community. By describing how SVG and XForms can be integrated that request can be answered while providing more functionality if required. For example, the tight integration with a data model of a form should allow an SVG/XForms implementation to package SOAP messages easily. It also would allow an author to provide multiple interfaces to the same form (SVG, CSS, VoiceXML).

It also should be possible to extend generic form controls to use an SVG rendering specified by the document author. Events within the SVG rendering should be linked to behavior that updates the form model.

At the time of publication, the Working Group is undecided as to whether or not the SVG specification should describe a default rendering and behavior for some form elements, such as buttons and sliders. We realize that creating widget sets is a deep topic and specifically request feedback on this matter. Would a simple set of form widgets be sufficient in most situations, or would authors prefer to always create the SVG rendering and behavior for every element?

Readers will notice the RCC section makes a number of references to XForms. The current feeling of the Working Group is enable XForms through this feature and by adding a small number of low-level widgets to the SVG language (such as text-entry).

5.2 Element focus and navigation

5.2.1 The focusable property

In many cases, such as text editing, the user is required to place focus on a particular element, ensuring that input events, such as keyboard input, are sent to that element.

focusable

Value:	"true" | "false" | "auto"
Initial:	"auto"
Applies to:	container elements and graphics elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The focusable property determines if an element can get keyboard focus (i.e. receive keyboard events) and participate in the "tab order". The value "true" means that the element is keyboard-aware and should be treated as any other UI component that can get focus. The value "false" means that it should not. The value "auto" is equivalent to "false", except that it acts like "true" for the following cases:

- the a element
- the text and flowDiv elements with editable set to "true"
- the top-level svg element

5.2.2 Navigation

By default, the tab key navigates between elements that can obtain focus (ie. elements for which the value of the focusable property evaluates to "true").

In the author wishes to change the default tab order, they must catch the input event related to the navigation (such as the tab keypress) and then cancel the event.

Navigation order is determined using the nav-index property from the CSS 3 Basic User Interface Module. In most cases, the value 'auto' will cause the user agent to use document order for navigation order. This property only applies to focusable elements.

Keyboard equivalents can be assigned to focusable elements using the key-equivalent property from the CSS 3 Basic User Interface Module. This property only applies to focusable elements.

5.2.3 Obtaining focus

When the user agent gives an element focus it receives a DOMFocusIn event.

The SVGElement and SVGElementInstance interfaces have a focus() method that, when called, requests that the User Agent give focus to the particular element. Calling focus() on an element that is not focusable has no effect.

Should this be the case? Should the focus() API ignore the property?

The SVGDocument interface have next() and previous() methods which move the focus onto the respectively next or previous focusable element.

The following open issues are yet to be discussed:

- API to get focus? (SVGElement::focus() or special interface)
- Can SVGElemenInstance get focus (elements referenced by use element)? Answer is probably yes.
- Should every instance get its own tab stop? Answer is probably yes.
- Changing the tab order? (cancel the Tab keyboard event and call focus())

5.3 Tooltips

The SVG 1.1 language does not specify a method for the declarative display of tooltips on SVG content. While it suggests that the content of the title element could be displayed as a tooltip, it does not provide any control for the content developer. This meant that developers resorted to implementing their own tooltip functionality using scripting.

SVG 1.2 adds declarative tooltip support through the tooltip property. This allows for the display of textual tooltips to be declaratively controlled for each element in the SVG document. User agents should use the platform tooltip system if there is one available. On platforms without native support for tooltips, user agents can implement their own tooltip system. This means that the appearance, position and behavior of the tooltip is implementation or platform specific.

However, in the visual environment, the user agent must attempt to display the entire tooltip in a readable manner, avoiding clipping by the edge of the device or canvas. If possible the tooltip should be implemented as a temporary graphic that is superimposed on the top of the SVG canvas at the location of the pointer if one exists. Also, if possible, the content of the tooltips should be made available to accessibility implementations on the device.

The SVG Working Group plans to add a feature to provide enhanced floating windows above the canvas, which would allow for more graphically rich tooltips. This may not be tied to the tooltip property, which provides the common functionality. That is, rich floating graphics are not considered tooltips for now.

5.3.1 The hint element

The hint element is another level of metadata for an element. The contents of the hint element are intended to be displayed by a tooltip. It differs from the title and desc elements in that a hint may give instructions to the user, as opposed to describe the element that it belongs to.

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2">

  <circle cx="50" cy="50" r="25" fill="red" tooltip="enable">
    <title>The target area</title>
    <hint>Click here to start the animation</hint>
    <animate .... />
  </circle>

</svg>
```

The following is an extract of the schema that describes the hint element:

```
<xs:element name="hint">
  <xs:complexType mixed="true">
    <!-- any attributes? -->
  </xs:complexType>
</xs:element>
```

5.3.2 The tooltip property

The tooltip property specifies whether or not tooltips should be displayed for this element.

tooltip

Value:	enable | disable | inherit
Initial:	enable

Applies to:	graphics and container elements
Inherited:	yes
Percentages:	N/A
Media:	visual
Animatable:	yes

If the tooltip property is set to "enable" then the content of the tooltip is the text content of the hint child of an element. For elements that do not have a hint child, the tooltip content is the content of its parent's tooltip. If the tooltip property is set to "disable" then the content of the tooltip is empty. The value of the tooltip for a root svg element without a hint child is empty. In the case of an empty value, the tooltip will not be displayed.

Tooltips and the CSS hover property both track the mouseover and mouseout events. Tooltips may require the pointer to be stationary over the target for a short period of time. Tooltips and hover represent additive effects. The hover processing should occur first followed by tooltip processing. That is, tooltip processing is placed after hover processing and before hyperlink processing. Tooltips respond to pointer events in the same manner as hover, thus do not activate on elements with either the display or pointer-events properties set to "none".

6 XML Events Integration

6.1 XML Events

XML Events is an XML syntax for integrating event listeners and handlers with DOM Event interfaces. Declarative event handling in SVG 1.1 is hardwired into the language, in that the developer is required to embed the event handler in the element syntax (e.g. an element has an onclick attribute). SVG 1.2 adds support for XML Events, providing the ability to listen to custom events, as well as specifying the event listener separately from the graphical content.

SVG 1.2 makes the following modifications to XML Events:

1. **Namespaced events**: As SVG 1.2 supports DOM Level 3 Events, which are namespaced, XML Events in SVG 1.2 much also allow namespaced events. SVG 1.2 follows the rules defined in DOM Level 3 (namespaces are specified as "namespace-prefix:event-name".
2. **URIREFs instead of IDREFs**: the observer and target attributes from XML Events are currently IDREFs. Since SVG 1.2 requires a declarative syntax for event handling in more than one document, it uses URIREFs for those attributes, with the following restriction: Only documents that are declaratively referenced as part of the current document, via the use, image and feImage elements, can be referred to. Referring to any other arbitrary external document is an error.

The following is an example of an SVG file using XML Events:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ev="http://www.w3.org/2001/xml-events">

  <rect id="myRect" x="10" y="20" width="200" height="300"
        fill="red"/>

  <!-- register a listener for a myRect.click event -->
  <ev:listener ev:event="click" ev:observer="myRect"
               ev:handler="#myClickHandler" />

  <handler id="myClickHandler" type="text/ecmascript">
    var myRect = document.getElementById("myRect");
    var width = parseFloat(myRect.getAttribute("width"));
    myRect.setAttribute("width", (width+10));
  </handler>

</svg>
```

In the above example, the ev:listener element registers that the myClickHandler element should be invoked whenever a "click" event happens on "myRect".

The handler element has been added to SVG 1.2 and is described in the following section.

The combination of the XML Events syntax and the new handler element allows event handling to be more easily processed in a compiled language. Below is an example of an event handler using the Java language:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ev="http://www.w3.org/2001/xml-events"
     xmlns:foo="http://www.example.com/foo">

  <rect id="myRect" x="10" y="20" width="200" height="300"
        fill="red"/>

  <!-- register a listener for a myRect.click event -->
  <ev:listener ev:event="click" ev:observer="myRect"
               ev:handler="#myClickHandler" />

  <handler id="myClickHandler" type="application/java"
           xml:base="http://example.com/myJar.jar"
           xlink:href="#com.example.MyXMLEventHandler"/>
      <foo:offset>10</foo:offset>
  </handler>

</svg>
```

In this case, the handler element specifies the location of compiled code that conforms to the XMLEventHandler interface. The user agent invokes the handleEvent method within the targeted interface.

In this case, the MyXMLEventHandler has the following definition:

```
package com.example;

import org.w3c.svg.XMLEventHandler;
import org.w3c.dom.Document;
import org.w3c.dom.Element;
import org.w3c.dom.events.Event;

public class MyXMLEventHandler implements XMLEventHandler {

  Document document;

  public void init(Document doc, Element handlerElement) {
    document = doc;
    // ...
  }

  public void handleEvent(Event event) {
    Element myRect = document.getElementById("myRect");
    float width = Float.parseFloat(myRect.getAttribute("width"));
    myRect.setAttribute(width, "" + (width + 10));
  }
}
```

The XMLEventHandler interface has been temporarily placed in the SVG package/namespace. The SVG Working Group will liaise with the HTML Working Group to provide an interface for this class.

The definition of the XMLEventHandler Interface is shown below:

```
/**
* XMLEventHandler
*/
interface XMLEventHandler extends org.w3c.dom.events.EventHandler {

 /**
  * Gives the handler an opportunity to do any type of
  * initialization it requires.
  * This should be called before the onload event is
  * dispatched on the Document.
  *
  * @param doc reference to the Document this handler is
  *        attached to
  * @param handler reference to the handler element
  */
 void init(in Document doc, in Element handler);
}
```

6.2 The handler element

The handler element is similar to the script element: its contents, either included inline or referenced, are code that is to be executed by the scripting engine(s) used by user agent.

However, where the script element evaluates its contents when the document is loaded, the handler element evaluates its contents in response to a event. This makes handler functionally equivalent to using the event attributes.

For example, consider the following SVG 1.1 document:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.1">

  <rect id="myRect" x="10" y="20" width="200" height="300" fill="red"
     onclick="var width =  parseFloat(
                  document.getElementById('myRect').getAttribute('width'));
              document.setAttribute('myRect', 'width', (width+10));"/>

</svg>
```

The above example can be rewritten to use the handler element and XML Events (described below) as shown:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ev="http://www.w3.org/2001/xml-events">

  <rect id="myRect" x="10" y="20" width="200" height="300" fill="red">

    <handler type="text/ecmascript" ev:event="click">
        var myRect = evt.target;
        var width = parseFloat(myRect.getAttribute("width"));
        myRect.setAttribute("width", (width+10));
    </handler>

  </rect>

</svg>
```

In ECMAScript, the contents of the handler element behave as if they are the contents of a new function object, created as shown:

```
function(evt) {
  // contents of handler
}
```

Other interpreted languages behave in as similar a manner as possible.

The 'evt' parameter shown above is an Event object corresponding to the event that has triggered the handler.

The following is a schema extract which defines the handler element:

```
<xs:element name="handler">
  <xs:complexType>
    <xs:attributeGroup ref="commonAttrs"/>
    <xs:attribute name="type" use="required"/>
    <xs:attribute ref="xlink:href"/>
    <xs:attribute ref="ev:event"/>
  </xs:complexType>
</xs:element>
```

Attributes:

type = "content-type":
: Identifies the language used for the handler element. The value specifies a media type, per RFC2045. Animatable: no.

xlink:href:
: If this attribute is present, then the script content of the handler element should be loaded from this resource. Animatable: no.

ev:event:
: The name of the event to handle.

For compiled languages, the xlink:href attribute has the same meaning as the combination of the classid and codebase attributes in HTML 4.01. The reference must resolve to a class that implements the XMLEventHandler interface (described below).

6.2.1 Parameters to handler elements

In many situations, the script author uses the handler as a template for calling other functions, using the content of the handler element to pass parameters. However, for compiled languages the handler element does not have any executable content.

In this case, the author should embed the parameters into the handler as custom content. The execution of the handler code retrieves the contents of the parameters using the DOM.

Below is an example of using parameters on the handler element:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:ev="http://www.w3.org/2001/xml-events"
     xmlns:foo="http://www.example.com/foo">

  <rect id="myRect" x="10" y="20" width="200" height="300"
        fill="red"/>

  <!-- register a listener for a myRect.click event -->
  <ev:listener ev:event="click" ev:observer="myRect"
               ev:handler="#myClickHandler" />

  <handler id="myClickHandler" type="application/java"
```

```
          xlink:href="http://example.com/myJar.jar#com.example.MyXMLEventHandler"/>
      <foo:offset value="10"/>
      <foo:person>
         <foo:name>Victor Vector</foo:name>
         <foo:age>42</foo:age>
      </foo:person>
  </handler>

</svg>
```

In this case, the object com.example.MyXMLEventHandler has its handleEvent method called whenever a 'click' event on the 'myRect' object is observed. The object can then retrieve the children of the handler element in order to obtain the contents of the elements from the "foo" namespace.

7 Multimedia enhancements

SVG 1.0 used SMIL Animation for its animation syntax. It has been a common request from the public to have more features from SMIL in SVG. For that reason, SVG 1.2 will mostly likely incorporate more of SMIL 2.0. In this document the audio, video and some timing elements are described. Future revisions will expand on the SMIL integration.

The current proposal is to add more SMIL elements into the SVG language. Alternatively, the SVG Working Group may produce a W3C Note which defines an SVG+SMIL profile, similar to the XHTML+SMIL profile.

It is worth noting what parts of SMIL 2.0 are *not* under consideration for SVG 1.2. SVG would probably not include SMIL Layout, Linking, Structure and MetaInformation.

7.1 The audio element

The audio element specifies an audio file which is to be rendered to provide synchronized audio. The usual SMIL animation features are used to start and stop the audio at the appropriate times. An xlink:href is used to link to the audio content. No visual representation is produced. However, content authors can if desired create graphical representations of control panels to start, stop, pause, rewind, or adjust the volume of audio content.

It is an open question what audio formats, if any, would be required for conformance. For the image element, SVG mandates support of PNG, JPEG and SVG formats and allows others. All three mandatory formats may be implemented without royalty payments. Many common audio formats, such as MP3, require payment of royalties. One option under consideration is the Vorbis audio compression in the Ogg format. Ogg/Vorbis audio files are believed to be implementable without royalty payments. Another option is to say that there are no required formats, and each implementation supports whatever format the operating system provides. Clearly, this would lead to non-interoperable, platform-dependent content.

The following is a extract of an XML Schema that describes the audio element.

```
<xs:element name="audio">
  <xs:complexType>
    <xs:complexContent>
      <xs:restriction base="xsd:anyType">
    </xs:restriction>
    <xs:attributeGroup ref="XLinkEmbedAttrs"/>
    <xs:attributeGroup ref="MediaAttrs"/>
  </xs:complexType>
</xs:element>
```

The following example illustrates the use of the audio element. When the button is pushed, the audio file is played three times.

```
<svg width="100%" height="100%" version="1.2"
     xmlns="http://www.w3.org/2000/svg"
     xmlns:xlink="http://www.w3.org/1999/xlink">

  <desc>SVG audio example</desc>

  <audio xlink:href="ouch.ogg" volume="0.7" type="audio/vorbis"
        begin="mybutton.click" repeatCount="3"/>

  <g id="mybutton">
    <rect width="150" height="50" x="20" y="20" rx="10"
      fill="#ffd" stroke="#933" stroke-width="5"/>
    <text x="95" y="55" text-anchor="middle" font-size="30"
      fill="#933">Press Me</text>
  </g>

  <rect x="0" y="0" width="190" height="90" fill="none" stroke="#777"/>

</svg>
```

When rendered, this looks as follows:

The DOM interface for the audio element is shown below:

```
interface SVGAudioElement :
                SVGAnimationElement,
                SVGURIReference,
                SVGLangSpace {

    readonly attribute SVGAudio audio;
};
```

7.2 The video element

The video element specifies a video file which is to be rendered to provide synchronized video. The usual SMIL animation features are used to start and stop the video at the appropriate times. An xlink:href is used to link to the video content. It is assumed that the video content also includes an audio stream, since this is the usual way that video content is produced, and thus the audio is controlled by the video element's media attributes.

The video element produces a rendered result, and thus has width, height, x and y attributes.

It is an open question what video formats, if any, would be required for conformance. For the image element, SVG mandates support of PNG, JPEG and SVG formats and allows others. All three mandatory formats may be implemented without royalty payments. Many common video formats, such as RealVideo, Quicktime movies or Windows media Format video, require payment of royalties for most common codecs. W3C would be interested in suggestions for a royalty-free video format that could be used in any free or commercial SVG implementation without royalty.

The following is a extract of an XML Schema that describes the video element.

```
<xs:element name="video">
  <xs:complexType>
    <xs:complexContent>
      <xs:restriction base="xsd:anyType">
    </xs:restriction>
    <xs:attribute name="x"/>
    <xs:attribute name="y"/>
    <xs:attribute name="width"/>
    <xs:attribute name="height"/>
    <xs:attribute name="preserveAspectRatio"/>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
    <xs:attributeGroup ref="XLinkEmbedAttrs"/>
    <xs:attributeGroup ref="MediaAttrs"/>
  </xs:complexType>
</xs:element>
```

The following example illustrates the use of the video element. The video content is partially obscured by other graphics elements. Experiments within the SVG working group have shown that adequate performance can be obtained by rendering the video in an offscreen buffer and then transforming and compositing it in the normal way, so that it behaves like any other graphical primitive such as an image or a rectangle. It may be scaled, rotated, skewed, displayed at various sizes, and animated.

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:xlink="http://www.w3.org/1999/xlink"
     width="420" height="340" viewBox="0 0 420 340">
  <desc>SVG 1.2 video example</desc>
    <g>
    <circle cx="0" cy="0" r="170" fill="#da4" fill-opacity="0.3"/>
    <video xlink:href="noonoo.avi" volume=".8" type="video/x-msvideo"
         width="320" height="240" x="50" y="50" repeatCount="indefinite"/>
    <circle cx="420" cy="340" r="170" fill="#927" fill-opacity="0.3"/>
    <rect x="1" y="1" width="418" height="338" fill="none"
       stroke="#777" stroke-width="1"/>
    </g>
</svg>
```

Show this example of the video element (requires an SVG 1.2 viewer and support for a Windows AVI using Motion JPEG. This is a 3.7M video file).

When rendered, this looks as follows:

The DOM interface for the video element is shown below:

```
interface SVGVideoElement :
                SVGAnimationElement,
                SVGURIReference,
                SVGLangSpace,
                SVGStylable,
                SVGTransformable {
  readonly attribute SVGAnimatedLength x;
  readonly attribute SVGAnimatedLength y;
  readonly attribute SVGAnimatedLength width;
  readonly attribute SVGAnimatedLength height;
  readonly attribute SVGAnimatedPreserveAspectRatio preserveAspectRatio;

  // a reference to the media stream interface
  readonly attribute SVGVideo video;
};
```

7.3 Media Properties

The audio and video elements described above both refer to a set of media attributes. For SVG 1.2 this set includes a single property, audio-level.

audio-level

Value:	<float>
Initial:	1
Applies to:	audio, video and container elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The audio-level property specifies a value between 0 and 1 that is used to calculate the volume of a particular element. Values above 1 and below 0 are clipped.

An element's volume is the product of its audio-level property and the element volume of its parent. The exception to this rule is the root element, where the element volume is only the value of its audio-level property. Therefore, element volume is calculated in a similar way to opacity.

This means that if you set the audio-level of an element to a value less than 1.0, all children elements will be quieter. It is not possible to increase the volume on an element.

The output signal level is calculated using the logarithmic scale described below (where vol is the value of the element volume):

```
dB change in signal level = 20 * log10(vol)
```

If the element has an element volume of 0, then the output signal will be inaudible. If the element has an element volume of 1, then the output signal will be at the system volume level. Neither the audio-level property or the element volume override the system volume setting.

7.4 Transition effects

There exist a number of usage scenarios for transition effects between views of SVG. For example, an image slideshow or multipage SVG documents.

SMIL 2.0 defines syntax for allowing the transition between multimedia elements to include a transition, such as a fadein/fadeout. There is a comprehensive set of transition effects defined by SMPTE and listed in an appendix of SMIL 2.0 Transition Effects

SVG 1.2 adds the transition effects from SMIL 2.0, in particular the transition element and the transIn and transOut attributes.

7.4.1 The transition element

The transition element defines a single transition class. A transition element can be the child of any class, although normally they are defined within a defs section.

The following is an extract of an XML Schema that describes the transition element:

```
<xs:element name="transition">
  <xs:complexType>
    <xs:attribute name="type" use="required"/>
    <xs:attribute name="subtype"/>
    <xs:attribute name="dur"/>
    <xs:attribute name="startProgress"/>
    <xs:attribute name="endProgress"/>
    <xs:attribute name="direction"/>
    <xs:attribute name="fadeColor"/>
  </xs:complexType>
</xs:element>
```

Attributes:

type
: The type of transition. This attribute is required and must be one of the transition families listed in the SMIL 2.0 Transitions Taxonomy.

subtype
: The subtype of the transition. If specified then the attribute must be a recognized subtype of the

transition type. If not specified, then the subtype is the default for the particular transition type.

dur
: The duration of the transition. If specified it must be a clock-value. The default value is "1s".

startProgress
: This is the amount of progress through the transition at which to begin execution. Legal values are real numbers in the range 0.0-1.0. For instance, we may want to begin a crossfade with the destination image being already 30% faded in. For this case, startProgress would be 0.3. The default value is 0.0.

endProgress
: This is the amount of progress through the transition at which to end execution. Legal values are real numbers in the range 0.0-1.0 and the value of this attribute must be greater than or equal to the value of the startProgress attribute. If endProgress is equal to startProgress, then the transition remains at a fixed progress for the duration of the transition. The default value is 1.0.

direction
: This specifies the direction the transition will run. The legal values are "forward" and "reverse". The default value is "forward". Note that this does not impact the media being transitioned to, but only affects the geometry of the transition. For instance, if you specified a type of "barWipe" and a subtype of "leftToRight", then the media would be wiped in by a vertical bar moving left to right. However, if you specified direction="reverse", then it would be wiped in by the same vertical bar moving right to left. Another example is the type of "starWipe" and subtype of "fourPoint". For this transition, running the transition forward reveals the destination media on the inside of a four-point star which starts small and gets larger as the transition progresses. Running this transition in reverse would reveal the destination media in the area outside of a large four-point star. The star begins large and gets smaller as the transition progresses. Note that not all transitions will have meaningful reverse interpretations. For instance, a crossfade is not a geometric transition, and therefore has no interpretation of reverse direction. Transitions which do not have a reverse interpretation should ignore the direction attribute and assume the default value of "forward".

fadeColor
: If the value of the "type" attribute is "fade" and the value of the "subtype" attribute is "fadeToColor" or "fadeFromColor", then this attribute specifies the starting or ending color of the fade. If the value of the "type" attribute is not "fade", or the value of the "subtype" attribute is not "fadeToColor" or "fadeFromColor", then this attribute is ignored. The allowed values are any color value or a reference to a solidColor object. The default value is "black".

None of the attributes on the transition element are animatable.

SVG 1.2 does not allow extensions to the transition types specified by SMIL 2.0.

7.4.2 The transition attributes

Once a transition has been defined in a document, then an transition effect is applied by referencing the transition from the transIn and transOut attributes. The transition attributes are added to the elements that can undergo a transition (listed below).

Transitions specified with a transIn attribute will begin at the beginning of the animation's active duration. Transitions specified with a transOut attribute will end at the end of the animation's active duration or end at the end of the element's fill state if a non-default fill value is applied.

Note that in SVG, the transition effects only apply to animations modifying the xlink:href attribute of graphical elements: image, video, use, page and feImage.

Transitions will most likely also apply to display of page elements, but this is yet to be defined.

The value of the attributes is a semicolon-separated list of transition element identifiers. The transition used is the first supported transition in the list.

Below is an example of a transition:

```
<svg width="100%" height="100%" version="1.2"
     xmlns="http://www.w3.org/2000/svg"
     xmlns:xlink="http://www.w3.org/1999/xlink">

  <defs>
    <transition id="fadeToRed2s" type="fade" subtype="fadeToColor"
                fadeColor="red" dur="2s"/>
    <transition id="fadeFromRed1s" type="fade" subtype="fadeFromColor"
                fadeColor="red" dur="1s"/>
  </defs>

  <image x="0" y="0" width="100" height="100"
         transIn="fadeFromRed1s"
         transOut="fadeToRed2s">

    <animate attributeType="XML"
             attributeName="xlink:href"
             begin="0s"
             dur="60s"
             values="1.jpg;2.jpg;3.jpg;4.jpg"
             fill="freeze"/>

  </image>

</svg>
```

7.5 Timing and Synchronization

The SMIL2 Timing and Synchronization module allows for simpler authoring of multimedia content with multiple elements. SVG 1.2 plans to add the par and seq elements in order to create synchronized presentations.

There are a number of attributes that should be added to SVG 1.2 in order to control the synchronization of timed content. These include syncBehavior, syncTolerance, syncMaster, timeContainer, and timeAction as well as expanding the range of allowed fill attribute values.

SVG 1.2 also plans to allow timed content, such as animations, to begin before the entire document is downloaded. This may require the addition of an attribute on the root svg element that marks the document as a particular time container.

See SMIL 2.0 Timing and Synchronization for more details.

7.6 More SMIL test attributes and events

SVG 1.2 is considering adding extra test attributes to better facilitate conditional content. Potential new attributes include: systemBitrate, systemCaptions, systemRequired, systemScreenDepth, systemScreenSize, systemAudioDesc, systemCPU, systemComponent, systemOperatingSystem, systemOverdubOrSubtitle.

Also, SVG 1.2 may add new events that better facilitate control of timed content. Potential new events include mediacomplete, mediaerror, outofsync, pause, reset, resume, reverse, seek, syncrestored, timeerror.

7.7 Animating the timeline's clock

The animateClock element allows the timeline of the referenced element to modified. It controls the clock on the timeline container or animation element.

For a timeline modification, animateClock updates the timeline's clock with its specified by or to values.

For example, the current clock time is 20s. A value of to="10s" would set the clock to 10s. A value of by="5s" would set the clock to 25s.

For an animation element clock modification, animateClock updates the animation's begin value to accomodate the to or by value specified on animateClock.

For example, suppose there is an animation element with a begin time of 15s and the current clock value is 30s. To fast forward the animation by 5s, animateClock would use by="5s", effectively setting the animation begin value to 10s (animation now appears it has been running for 20s). To rewind the animation by 5s, animateClock would use by="-5s", effectively setting the animation begin value to 20s (animation now appears as if it has been running for 10s). To set the animation as if it started 10s ago, animateClock would use to="10s", effectively setting the animation begin time to 20s. To set the animation to start in 10s, animateClock would use to="-10s", effectively setting the animation begin time to 40s.

A schema for animateClock will be provided in the next draft.

7.8 Time Manipulation

SVG 1.2 adds the speed attribute from the SMIL 2.0 Timing Manipulations Module.

The speed attribute controls the local playback speed of an element, to speed up or slow down the effective rate of play relative to the parent time container. The speed attribute is supported on all timed elements. The argument value does not specify an absolute play speed, but rather is relative to the playback speed of the parent time container. The specified value cascades to all time descendants. Thus if a par and one of its children both specify a speed of 50%, the child will play at 25% of normal playback speed.

Values less than 0 are allowed, and cause the element to play backwards. An element can only play backwards if there is sufficient information about the simple and active durations. Specifically:

- The element simple duration must be resolved and may not be indefinite.
- The element active duration must be resolved and not indefinite, OR the element active duration must be constrained by a resolved simple duration for its associated time container. There must be a means of defining active time running backwards.

If the cascaded speed value for the element is negative and if either of the above two conditions is not met, the element will begin and immediately end (i.e. it will behave as though it had a specified active duration of 0).

The SVG Working Group is considering adding more timing manipulation controls, in particulat the accelerate and decelerate attributes.

8 Multiple Pages

The SVG Print requirements document includes a request for the storage of multiple pages within a single SVG file. In particular, there is the need to display only a single page at any time, called the "current page", with the user agent providing a method to advance pages.

The concept of multiple pages has been introduced to SVG. Any SVG file can have a single container element, the pageSet which must be the last child element of the top-most svg element. Within a pageSet there are any number of page elements. A page element is a container with special scoping rules (described below) and its own nested timeline (to allow animations to start as the document is loaded, also described below). Only one page element is displayed by the user agent at any time on the main canvas. However a user agent is able to provide an alternate view, in a separate canvas if possible, to facilitate operations such as print preview, where multiple pages may be displayed at once.

No SVG content is allowed between the pageSet and the root svg element.

The pageSet element introduces different reference scoping rules from the rest of the SVG language. Each page element has a local scope. References in a page can only be to elements within the same page or in the root svg document (i.e. before the pageSet element). It is an error to refer to content in a different page element. External references are permitted, but authors are strongly encouraged to use the externalResourcesRequired feature if necessary.

It is intended that pageSet and page also be used to facilitate streaming animation. That is, some animations (eg. cartoons) can be considered as a set of scenes shown in sequence. Each page represents a scene in the animation. The combination of page and the timelineStart attribute (described below) provide a method to stream long-running declarative animations.

Each page element has a local timeline. Typically this means that animations within the page element are on a different timeline from the global timeline. The page timeline is reset when the page is displayed. The page timeline is paused when the page is not displayed. Authors can control when the timeline begins for a page element by using the timelineStart attribute (described below). Each page can have animation timing attributes that specify the duration a page should be visible. A pageSet element acts like a seq element.

A page can have transition effects apply as the user agent moves from one page to the next.

Below is an example of an SVG document with multiple pages:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     streamable="true">

   <defs>
     <!-- definitions here are always available -->
   </defs>

   <g>
     <!-- graphics here are always visible -->
   </g>

   <pageSet>
      <page>
        <!-- graphics for page 1 go here -->
      </page>

      <page orientation="90">
        <!-- graphics for page 2 go here -->
      </page>

      <page>
        <!-- graphics for page 3 go here -->
      </page>
   </pageSet>

</svg>
```

8.1 The pageSet element

```
<xs:element name="pageSet">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="page" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

The pageSet element contains a set of page elements which are the pages contained within this document.

A user agent renders all content outside the pageSet in the normal manner. However, only one page child of the pageSet is to be displayed at a time, as if all pages except the current page have their display property set to "none". This enables a multiple page SVG document to have a concept of a "master" page that contains graphics to be displayed on every page. The "master" content should be included outside the pageSet element, as part of the root svg content.

8.2 The page element

The page element contains graphics that are to be rendered when the page is the current page.

```
<xs:element name="page">
  <xs:complexType>
    <xs:sequence>
      <xs:group ref="GraphicsElements" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
    <xs:attribute ref="viewBox"/>
    <xs:attribute ref="preserveAspectRatio"/>
  </xs:complexType>
</xs:element>
```

Conceptually, the page element is similar to an svg element, but without transformation and positioning. All pages are in coordinate system of their pageSet, which is in the coordinate system of the root svg element.

8.3 The page-orientation property

When printing an SVG file, the definition of most printing properties, such as paper size, printer tray and double-sided, is controlled by the system (commonly called the job ticket) and is not part of the SVG content. There are two printing properties that can be defined by the SVG content itself, in both cases to assist in on-screen display.

The SVG content typically defines a page dimension or aspect ratio in the topmost svg element and its viewBox. The viewBox transformation applies to printed SVG in the same way as screen display.

The orientation of each page element can be controlled by the page-orientation property. This enables the content to define whether a portrait or landscape mode is used for display and printing.

page-orientation

Value:	-270 | -180 | -90 | 0 | 90 | 180 | 270
Initial:	0
Applies to:	page elements

Inherited:	no
Percentages:	N/A
Media:	visual print
Animatable:	yes

When displaying a page on screen the value of the page-orientation property introduces the following transform before the top-level viewport transformation:

0
: No additional transform

-90 or 270
: translate(0 height) rotate(-90)

180 or -180
: translate(width height) rotate(180)

90 or -270
: translate(width 0) rotate(90)

The values for width and height are the dimensions of the top-level viewBox in the user coordinate system or the dimensions of the top-level viewport if there is no viewBox specified.

This transformation is only applied when displaying on the screen in a manner that expects the orientation of the page to be convenient to the user. For example, a print preview dialog would not apply this transformation.

Below is an example of the page-orientation property:

```
<svg width="8.5in" height="11in" viewBox="0 0 612 792">
  <rect x="36" y="36" width="540" height="720"
        fill="yellow" stroke-width="15" stroke="black"/>
  <pageSet>
     <page>
        <text font-size="30" x="72" y="108">This is portrait</text>
     </page>
     <page page-orientation="90">
        <text font-size="30" x="72" y="108">This is landscape</text>
     </page>
   </pageSet>
</svg>
```

The above example is equivalent to the following two pages when printed:

```
<svg width="8.5in" height="11in" viewBox="0 0 612 792">
  <rect x="36" y="36" width="540" height="720"
        fill="yellow" stroke-width="15" stroke="black"/>
  <text font-size="30" x="72" y="108">This is portrait</text>
</svg>

<svg width="8.5in" height="11in" viewBox="0 0 612 792">
  <rect x="36" y="36" width="540" height="720"
        fill="yellow" stroke-width="15" stroke="black"/>
  <text transform="translate(612 0) rotate(90)"
        font-size="30" x="72" y="108">This is portrait</text>
</svg>
```

And equivalent to the following two pages when viewed:

```
<svg width="8.5in" height="11in" viewBox="0 0 612 792">
  <rect x="36" y="36" width="540" height="720"
```

```
        fill="yellow" stroke-width="15" stroke="black"/>
  <text font-size="30" x="72" y="108">This is portrait</text>
</svg>

<svg width="11in" height="8.5in" viewBox="0 0 792 612">
    <!-- fake top-level transform -->
  <g transform="translate(0 612) rotate(-90)">
    <rect x="36" y="36" width="540" height="720"
          fill="yellow" stroke-width="15" stroke="black"/>
    <text transform="translate(612 0) rotate(90)"
          font-size="30" x="72" y="108">This is portrait</text>
  </g>
</svg>
```

In the printing environment, the printing system can override the value of this property. For example, the user may wish to print all pages in portrait mode.

8.4 Navigation between pages

The SVG document has the concept of a current page. Only the current page is displayed on the main canvas at any time. The current page is also the only page with an active timeline.

The index of the current page is stored in the currentPage attribute on the SVGSVGElement interface. By modifying this attribute, the currently displayed page can be controlled.

It is also suggested that user agents bind input methods, such as the PageUp and PageDown keys if available, to page navigation.

It is expected that a streamed animation using multiple pages will automatically navigate between pages, once the scene representing the current page has ended. This will be described in a future draft.

Future versions of this document will most likely introduce an animation function specific to navigation between pages, such as animatePage. It is also likely that events specific to the display of a page will be introduced.

9 Streaming

The SVG working group is considering streaming enhancements to the SVG language. Here are two identified uses for streaming:

1. The SVG Print specification has relatively low-end printers as a potential target. These devices may have various limitations such as memory. It might be a requirement of SVGP that elements can be rendered and discarded immediately, thereby removing the need for maintaining an in-memory DOM for the document.
2. For time-based SVG applications viewed on a display device, we would like SVG to allow time-based elements such as animations to start while the rest of the document is still downloading.

To meet the requirements of these use cases, SVG 1.2 adds a method to mark streamed content as available for discard and a method to control the start of an element's local time.

9.1 The timelineBegin attribute

The timelineBegin attribute controls the initialization of the timeline on a time container.

timelineBegin = "onLoad" | "onStart"

onLoad:
: This is the default value. The element's timeline starts the moment the SVGLoad event for the element is triggered.

onStart:
: The element's timeline starts at the moment the element's open tag is fully parsed and processed.

For streaming animations, the author would typically set the root svg element, which controls the global timeline, to "onStart", thus allowing the nested timelines to begin as the document arrives. The page elements, which normally represent scenes in the animation, typically use the default value of "onLoad", ensuring that the entire scene is loaded before the nested timeline begins.

The timelineBegin attribute only affects time containers.

A future draft will explicitly state which elements can have nested timelines. For now it is only svg and page elements.

9.2 The streamedContents attribute

The streamedContents attribute allows an author to mark the contents of a document as unnecessary. It is allowed on the root svg element.

streamedContents = "keep" | "discard"

keep:
: This is the default value. The entire contents of document must be available while the document is being used.

discard:
: The contents of the document may be discarded as they are used. It is not a requirement that the contents are discarded.

In effect, this attribute controls whether or not a user agent is able to discard the contents of the page elements that have already been displayed.

10 Modifications to the Rendering Model

The SVG Working Group are considering a number of modifications to the rendering model for SVG 1.2. As the rendering model is perhaps the most important concept in the graphical representation of SVG content, any change to the model has to both fulfill a strong requirement and to be extremely carefully checked in order to not introduce inconsistencies, break existing content or have a substantial negative effect on implementations.

10.1 Enhanced Alpha Compositing

SVG 1.0 uses a simple rendering model, the Painter's Model, where a graphical object is composited onto the canvas above the objects that came before it in the document. While there is the ability to allow enhanced compositing within the filter system, there is no way to remove painting operations once they have been composited to the canvas. There are some usage scenarios where it would be advantageous to allow the enhanced compositing operations inline (ie. outside of the SVG 1.0 filter mechanism) since it may allow an implementation to perform the operation without rasterization. When placing graphical objects on the canvas, the result will be dependent on input color and opacity, the existing color and opacity on the canvas and the compositing operation. This will allow objects to remove "paint" from the canvas.

10.1.1 Introduction

SVG supports the following clipping/masking features:

- alpha compositing, which may be used each time a new element is placed on the canvas. The operation specified determines the combination of source color / alpha and destination color / alpha.
- clipping paths, which uses any combination of path, text and basic shapes to serve as the outline of a (in the absence of anti-aliasing) 1-bit mask, where everything on the "inside" of the outline is allowed to show through but everything on the outside is masked out
- masks, which are container elements which can contain graphics elements or other container elements which define a set of graphics that is to be used as a semi-transparent mask for compositing foreground objects into the current background.

One key distinction between a clipping path and a mask is that clipping paths are hard masks (i.e., the silhouette consists of either fully opaque pixels or fully transparent pixels, with the possible exception of anti-aliasing along the edge of the silhouette) whereas masks consist of an image where each pixel value indicates the degree of transparency vs. opacity. In a mask, each pixel value can range from fully transparent to fully opaque.

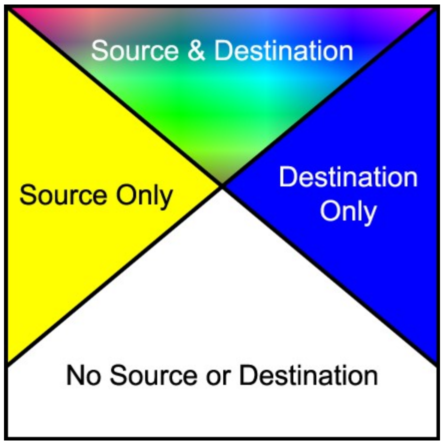
Note that masking with an element containing only color components with full luminance (e.g. r=g=b=1), will produce the equivalent result to compositing using the **src-in** or **dst-in** operators.

10.1.2 Alpha compositing

Graphics elements are composited onto the elements already rendered on the canvas based on an extended Porter-Duff compositing model, in which the resulting color and opacity at any given pixel on the canvas depend on the 'comp-op' specified. The base set of 12 Porter-Duff operations shown below always result in a value between zero and one, and as such, no clamping of output values is required.

In addition to the base set of 12 Porter-Duff operations, a number of blending operations are supported. These blending operations are extensions of the base Porter-Duff set and provide enhanced compositing behavior. The extended operations may result in color and opacity values outside the range zero to one. The opacity value should be clamped between zero and one inclusive, and the pre-multiplied color value should be clamped between zero and the opacity value inclusive.

The following diagram shows the four different regions of a single pixel considered when compositing.



Depending on the compositing operation the resultant pixel includes input from one or more of the regions in the above diagram. For the regions where only source or destination are present, a choice of including or not including the input is available. For the region where both are present, various options are available for the combination of input data.

For groups containing compositing operators, the operation used to composite the group onto the canvas is the comp-op property of the container element itself. Other container element properties such as opacity specify operations to be performed to the group between the steps of combining the children, and compositing the group onto the background. The enable-background and knock-out properties specify the state the group buffer is initialized to prior to use, any modification to the compositing of the group's children, and in some cases a post rendering step to be performed after rendering the children and prior to any other post rendering steps.

Implementation note: Various container elements calculate their bounds prior to rendering. For example, rendering a group generally requires an off-screen buffer, and the size of the buffer is determined by calculating the bounds of the objects contained within the group. SVG 1.0 implementations generally calculated the bounds of the group by calculating the union of the bounds of each of the objects within the group. Depending on the compositing operations used to combine objects within a group, the bounds of the group may be reduced, and so, reduce the memory requirements. For example, if a group contains two objects - object A 'in' object B - then the bounds of the group would be the intersection of the bounds of objects A and B as opposed to the union of their bounds.

Implementation Note: While container elements are defined as requiring a buffer to be generated, it is often the case that a user agent using various optimizations can choose not to generate this buffer. For example, a group containing a single object could be directly rendered onto the background rather than into a buffer first.

The following variables are used to describe the components of the background, group and extra opacity channel buffers.

```
Sc              Non-premultiplied source color component
Sca             Premultiplied source color component
Sra Sga Sba     Premultiplied source color component
Sa              Source opacity component
Dc              Non-premultiplied destination color component
Dca             Premultiplied destination color component
Dra Dga Dba     Non-premultiplied destination color component
Da              Destination opacity component
Da(d)           Extra opacity buffer containing the percentage
                of the background channel in the group buffer.
D<n>            Destination buffer <n> where the background is 0,
                groups in the top level svg element 1, nested groups
                2 and so forth
```

```
D'              The results of the destination post a compositing step
```

The operation used to place objects onto the background is as follows:

```
      Dca' = f(Sc, Dc).Sa.Da  + Y.Sca.(1-Da)  + Z.Dca.(1-Sa)
      Da'  =         X.Sa.Da  + Y.Sa.(1-Da)   + Z.Da.(1-Sa)
```

Depending on the compositing operation, the above equation is resolved into an equation in terms of pre-multiplied values prior to rendering. The following are specified for each compositing operation:

```
      X, Y, Z, f(Sc, Dc)
```

defined as:

```
f(Sc,Dc)    The intersection of the opacity of the source and destination
            multiplied by some function of the color. (Used for color)

X           The intersection of the opacity of the source and destination.
            (Used for opacity)

Y           The intersection of the source and the inverse of the destination.

Z           The intersection of the inverse of the source and the destination.
```

Depending on the compositing operation, each of the above values may or may not be used in the generation of the destination pixel value.

10.1.3 The clip-to-self property

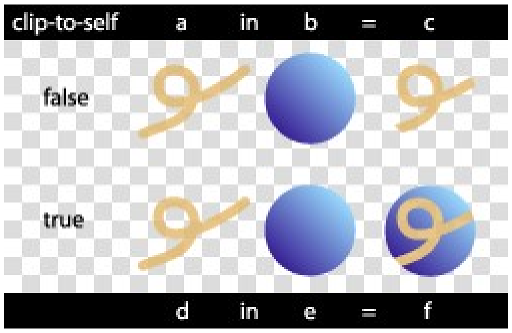
clip-to-self

Value:	true | false | inherit
Initial:	false
Applies to:	container elements and graphics elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The clip-to-self property determines if the object effects pixels not covered by the object. Some compositing operations effect pixels where the source graphic is completely transparent. Regions where the source graphic does not cover, one of two operations can be performed. Setting clip-to-self to true means that compositing an object only effects the pixels covered by the object. Setting clip-to-self to false means that compositing an object effects all pixels on the canvas by compositing completely transparent source onto the destination for areas not covered by the object.

Note that most compositing operations do not remove the destination and as such for these operations, the clip-to-self property has no effect. The compositing operations that remove background are described in the comp-op property diagram and can be easily identified as those that remove the blue region in the right of each of the diagrams. These are clear, src, src-in, dst-in, src-out and dst-atop. For all other operators the clip-to-self property has no effect.

The clip-to-self property provides compatibility with Java2D.

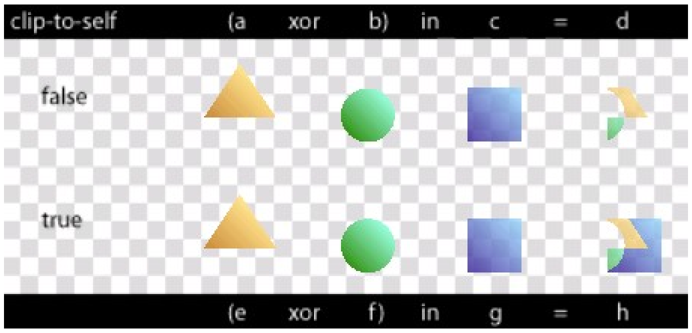


View this image as SVG (SVG-enabled browsers only)

Container elements where the clip-to-self property is set to true only effect the pixels within the extent of the elements within the container element. For example, if a container element contains two circles, and the container element has the clip-to-self property set to true, then nothing outside the circles is effected. To perform this operation, the renderer needs to keep track of the extent of each of the elements within the container element and ensure that nothing outside the elements is modified. This can be produced by converting each object to a clipping path and unioning the clipping paths together to produce a clipping path that represents the extent of all the elements within the container element. Where a container element contains nested container elements, the operation is performed within the sub-container elements to produce the final path. When the group is composited onto the page, it is composited through the clipping path generated and thus nothing outside the extent of all the elements within the container element is modified.

For filled and stroked shapes and text, the object is directly converted to a clipping path. For images and filters, the bounds of the object is converted to a (possibly transformed) rectangular clipping region.

Implementation Note: For some container elements where the clip-to-self property is set to false, the container element might effect the background outside bounds of the container element.



View this image as SVG (SVG-enabled browsers only)

10.1.4 The enable-background property

enable-background

Value:	accumulate | new [x y width height] | inherit
Initial:	accumulate
Applies to:	container elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	no

For a container element with enable-background set to "new", the container element's buffer is initially cleared to transparent. This buffer is treated as the canvas for the complex group's children. When the complete contents of the container element are rendered onto the buffer, the buffer is composited onto the canvas, using the container element's specified compositing operation.

For a container element with enable-background set to "accumulate", the corresponding area of the canvas is copied into the container element's buffer. A second buffer which has only an opacity channel is also created. This buffer Da(d) stores the percentage of the background in the group buffer and is initially opaque (which is consistent because the background has just been copied into the group buffer). The group buffer is treated as the canvas for the children of the group as usual. Additionally, as objects are placed into the group buffer, the Da(d) buffer is also drawn into using one of the operations listed below. Before the group buffer is composited onto the canvas, any remaining background color in the group buffer is removed using the values in the Da(d) buffer. Other post rendering steps such as the opacity are performed after this step, and before compositing the result onto the canvas. In addition the compositing operation used to place a group with enable-background set to accumulate onto its background is modified to apply any reduction to the background caused by any of the objects in the group.

When drawing elements within a container element with enable-background set to "accumulate", the standard equations as listed below are used to draw the object into the group buffer. Depending on the compositing operation, one of two operations listed below are used to draw the object into the extra transparency buffer Da(d).

For the operations clear, src, src-in, dst-in, src-out and dst-atop:

```
Da(d)' = 0
```

For all other compositing operations:

```
Da(d)' = Da(d).(1 - Sa)
```

When compositing the group buffer onto the background, rather than the standard compositing operation listed above, the following operations should be used:

```
Dca0' = f(Dc1,Dc0).Da1.Da0 + Y.Dca1.(1-Da0) + Z.Dca0.(1-Da1(d))
Da0'  =           X.Da1.Da0 + Y.Da1.(1-Da0)  + Z.Da0.(1-Da1(d))
```

Note that the last term in the above equations uses the Da(d) buffer rather than Da.

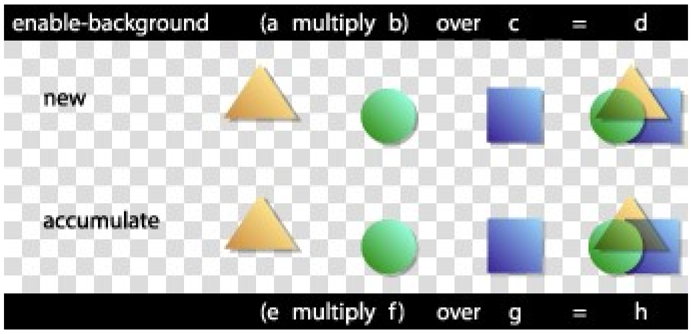
Elements containing a comp-op property value of clear, src, dst, dst-over, src-in, dst-in, src-out, dst-out, src-atop, dst-atop, xor can potentially reduce the opacity of the destination and are only valid where one of the elements ancestor container element has the enable-background property set to new. For elements without an ancestor with the enable-background property set to new , these operations are technically an error. A user agent should ignore the operation specified and render the element using the src-over compositing operation.

Filters have access to the nearest ancestor group's buffer through the BackgroundImage and BackgroundAlpha images. The buffer created for the ancestor group element of the element referencing the filter, is passed to the filter. Where no ancestors of the element referencing the filter contain an enable-background property value of new, transparent black is passed as input to the filter.

The optional x, y, width, height parameters on the new value indicate the subregion of the container element's user space where input filters have access to the background image. These parameters enable the SVG user agent potentially to allocate smaller temporary image buffers than the effective bounds of the container element. Thus, the values x, y, width, height act as a clipping rectangle on the background image canvas. Negative values for width or height are an error. If more than zero but less than four of the values x, y, width and height are specified or if zero values are specified for width or height, BackgroundImage and BackgroundAlpha are processed as if enable-background property was set to accumulate.

Implementation Note: While container elements are defined as requiring a buffer to be generated, it is often the case that a user agent using various optimizations can choose not to generate this buffer. For example, a group containing a single object could be directly rendered onto the background rather than into a buffer first.

Where a filter references an area of the background image outside the area specified by x, y, width, height, transparent is passed to the filter.



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10.1.5 The knock-out property

knock-out

Value:	true | false | inherit
Initial:	false
Applies to:	container elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	no

For a complex group where the knock-out property is set, the buffer is created as usual. The initial contents of the buffer created, and whether a secondary opacity channel is created depends on the value of the enable-background property. For each object within the container element, the object color and opacity replaces that of other objects within the container element, rather than overlaying it as for normal compositing. In effect, the destination input to the compositing operations for the complex group's children is the original contents of the buffer, rather than the current buffer for the complex group.

For knock-out = false:

```
Dca1' = f(Sca, Sa, Dca1, Da1)
Da1' = f(Sa, Da1)
```

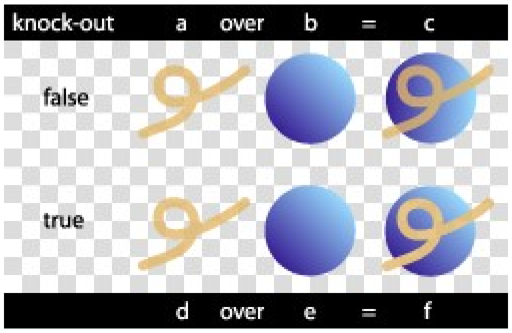
For knock-out = true, enable-background = new:

```
Dca1' = f(Sca, Sa, 0, 0)
Da1' = f(Sa, 0)
```

For 'knock-out' =true ,'enable-background' = accumulate:

```
Dca1' = f(Sca, Sa, Dca0, Da0)
Da1' = f(Sa, Da0)
```

Note that an element in a knockout group that does not have the clip-to-self property set, in effect clears all prior elements in the group.



View this image as SVG (SVG-enabled browsers only)

This definition of knock-out may differ to PDF and may be reviewed.

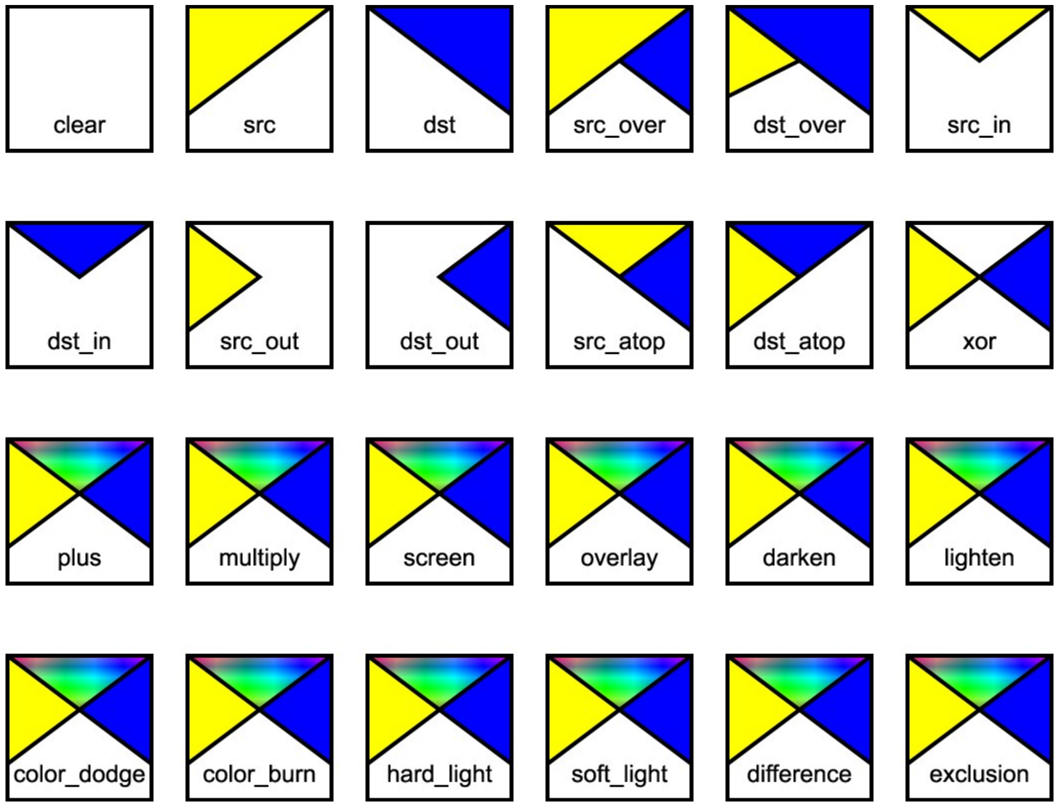
10.1.6 The comp-op property

comp-op

Value:	clear | src | dst | src-over | dst-over | src-in | dst-in | src-out | dst-out | src-atop | dst-atop | xor | plus | multiply | screen | overlay | darken | lighten | color-dodge | color-burn | hard-light | soft-light | difference | exclusion | inherit
Initial:	src-over
Applies to:	container elements and graphics elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The comp-op property determines the compositing operation used when placing elements onto the canvas. The canvas contains color components and an optional alpha component. When placing new elements onto the canvas, the resulting pixel values on the canvas are calculated using the equations listed in the sections below.

The diagram below shows the sub-pixel regions output by each of the compositing operations.



For many of the operators below, the destination is modified in regions of the image where the source is completely transparent. Pixels that the source does not touch are considered transparent, and as such may be modified, depending on the compositing operation. As discussed in the previous section, the bounds of the parent container element can be optimized to save in memory usage and hence, pixel writing requirements. Once the bounds of the parent container element have been determined, each element can only affect the pixels within those bounds.

The following operators change pixels where the source is transparent: clear src src-in dst-in src-out dst-atop

Implementation Note: The user agent may be required to create a backing store in which to generate a container element. The size of the backing store for a container element using the default compositing operator src-over is simply the union of the bounds of the sub-elements of the container element. When other compositing operators are used, the bounds of the container element are determined using the compositing operator diagram above. Starting with an empty bounds, the bounds of each successive object within the container element either replaces, is unioned with the result, or intersected depending on the compositing operator. For most compositing operators, the bounds are unioned with the result. For clear, the current result is set to empty. For src, src-out and dst-atop, the bounds are set to the source bounds. For dst, dst-out and src-atop, the bounds are left unchanged. For src-in and dst-in the bounds are intersected with the result.

All color components listed below refer to color component information pre-multiplied by the corresponding alpha value. The following identifiers have the attached meaning in the equations below:

```
Sc  - The source element color value.
Sa  - The source element alpha value.
Dc  - The canvas color value prior to compositing.
Da  - The canvas alpha value prior to compositing.
Dc' - The canvas color value post compositing.
Da' - The canvas alpha value post compositing.
```

clear

Both the color and the alpha of the destination are cleared. Neither the source nor the destination are used as input.

```
f(Sc,Dc)  = 0
X         = 0
Y         = 0
Z         = 0

Dca' = 0
Da'  = 0
```

src

The source is copied to the destination. The destination is not used as input.

```
f(Sc,Dc)  = Sc
X         = 1
Y         = 1
Z         = 0

Dca' = Sca.Da + Sca.(1 - Da)
     = Sca
Da'  = Sa.Da + Sa.(1 - Da)
     = Sa
```

dst

The destination is left untouched.

```
f(Sc,Dc)  = Dc
X         = 1
Y         = 0
Z         = 1

Dca' = Dca.Sa + Dca.(1 - Sa)
     = Dca
Da'  = Da.Sa + Da.(1 - Sa)
     = Da
```

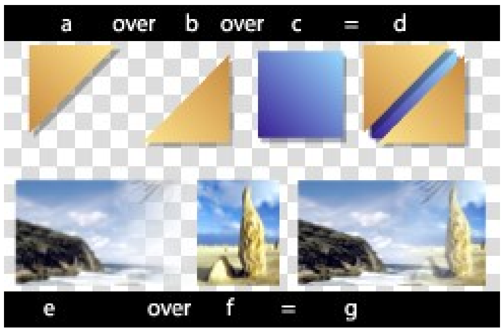
src-over

The source is composited over the destination.

```
f(Sc,Dc)  = Sc
X         = 1
Y         = 1
Z         = 1

Dca' = Sca.Da + Sca.(1 - Da) + Dca.(1 - Sa)
     = Sca + Dca.(1 - Sa)
Da'  = Sa.Da + Sa.(1 - Da) + Da.(1 - Sa)
     = Sa + Da - Sa.Da
```

The following diagram shows src-over compositing:



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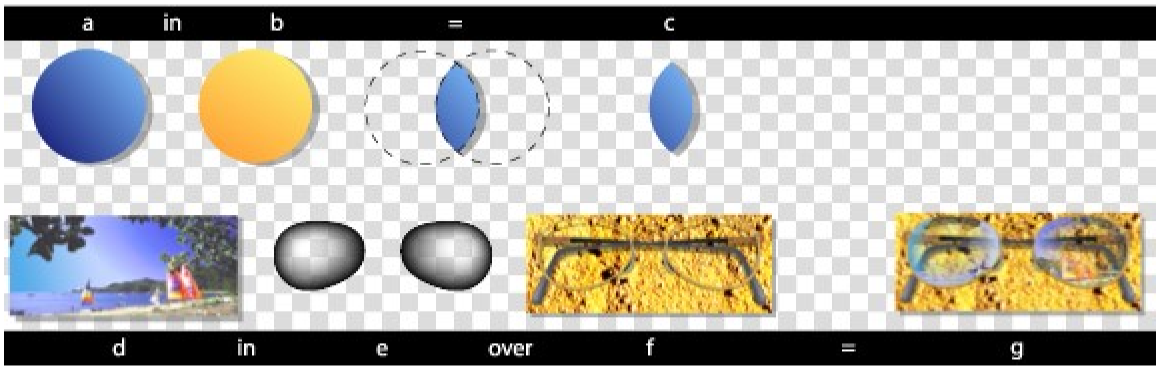
dst-over
The destination is composited over the source and the result replaces the destination.

```
f(Sc,Dc)  = Dc
X         = 1
Y         = 1
Z         = 1

Dca' = Dca.Sa + Sca.(1 - Da) + Dca.(1 - Sa)
     = Dca + Sca.(1 - Da)
Da'  = Da.Sa + Sa.(1 - Da) + Da.(1 - Sa)
     = Sa + Da - Sa.Da
```

src-in
The part of the source lying inside of the destination replaces the destination.

```
f(Sc,Dc)  = Sc
X         = 1
Y         = 0
Z         = 0

Dca' = Sca.Da
Da'  = Sa.Da
```

The following diagram shows src-in compositing:



View this image as SVG (SVG-enabled browsers only)

dst-in
The part of the destination lying inside of the source replaces the destination.

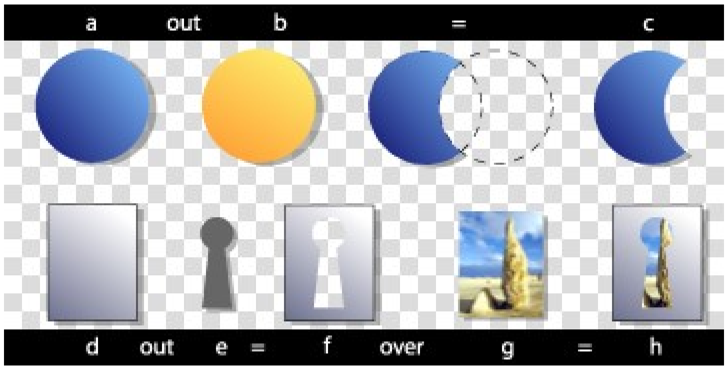
```
f(Sc,Dc)  = Dc
X         = 1
Y         = 0
Z         = 0

Dca' = Dca.Sa
Da'  = Sa.Da
```

src-out
The part of the source lying outside of the destination replaces the destination.

```
f(Sc,Dc)  = 0
X         = 0
Y         = 1
Z         = 0
```

```
Dca' = Sca.(1 - Da)
Da'  = Sa.(1 - Da)
```

The following diagram shows src-out compositing:



View this image as SVG (SVG-enabled browsers only)

dst-out

The part of the destination lying outside of the source replaces the destination.

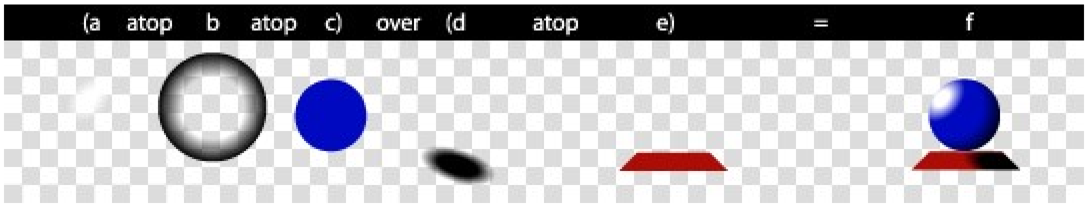
```
f(Sc,Dc)  = 0
X         = 0
Y         = 0
Z         = 1

Dca' = Dca.(1 - Sa)
Da'  = Da.(1 - Sa)
```

src-atop

The part of the source lying inside of the destination is composited onto the destination.

```
f(Sc,Dc)  = Sc
X         = 1
Y         = 0
Z         = 1

Dca' = Sca.Da + Dca.(1 - Sa)
Da'  = Sa.Da + Da.(1 - Sa)
     = Da
```

The following diagram shows src-atop compositing:



View this image as SVG (SVG-enabled browsers only)

dst-atop

The part of the destination lying inside of the source is composited over the source and replaces the destination.

```
f(Sc,Dc) = Dc
X        = 1
Y        = 1
Z        = 0

Dca' = Dca.Sa + Sca.(1 - Da)
Da'  = Da.Sa + Sa.(1 - Da)
     = Sa
```

xor

The part of the source that lies outside of the destination is combined with the part of the destination that lies outside of the source.

```
f(Sc,Dc) = 0
X        = 0
Y        = 1
Z        = 1

Dca' = Sca.(1 - Da) + Dca.(1 - Sa)
Da'  = Sa.(1 - Da) + Da.(1 - Sa)
     = Sa + Da - 2.Sa.Da
```

The following compositing operators add blending of source and destination colors beyond the base 12 Porter-Duff operations. The behavior of these operators necessitates clamping of the output values after compositing.

plus

The source is added to the destination and replaces the destination. This operator is useful for animating a dissolve between two images.

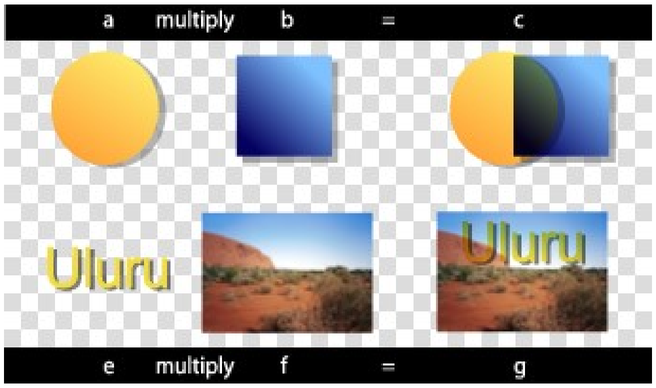
```
f(Sc,Dc) = Sc + Dc
X        = 1
Y        = 1
Z        = 1

Dca' = Sca.Da + Dca.Sa + Sca.(1 - Da) + Dca.(1 - Sa)
     = Sca + Dca
Da'  = Sa.Da + Da.Sa + Sa.(1 - Da) + Da.(1 - Sa)
     = Sa + Da
```

multiply

The source is multiplied by the destination and replaces the destination. The resultant color is always at least as dark as either of the two constituent colors. Multiplying any color with black produces black. Multiplying any color with white leaves the original color unchanged.

```
f(Sc,Dc) = Sc.Dc
X        = 1
Y        = 1
Z        = 1

Dca' = Sca.Dca + Sca.(1 - Da) + Dca.(1 - Sa)
Da'  = Sa.Da + Sa.(1 - Da) + Da.(1 - Sa)
     = Sa + Da - Sa.Da
```

The following diagram shows multiply compositing:



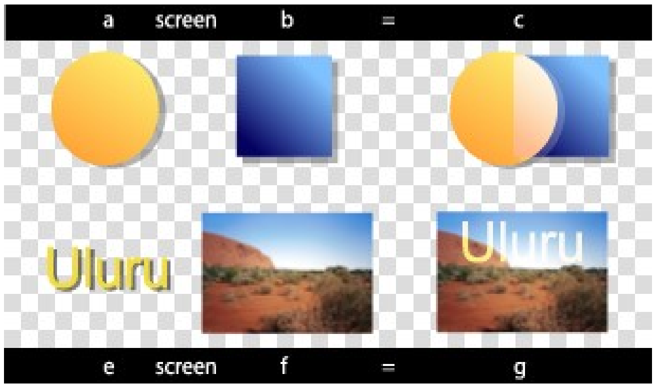
View this image as SVG (SVG-enabled browsers only)

screen

The source and destination are complemented and then multiplied and then replace the destination. The resultant color is always at least as light as either of the two constituent colors. Screening any color with white produces white. Screening any color with black leaves the original color unchanged.

```
f(Sc,Dc) = Sc + Dc - (Sc.Dc)

X         = 1
Y         = 1
Z         = 1

Dca' = (Sca.Da + Dca.Sa - Sca.Dca) + Sca.(1 - Da) + Dca.(1 - Sa)
     = Sca + Dca - Sca.Dca
Da'  = Sa + Da - Sa.Da
```

The following diagram shows screen compositing:



View this image as SVG (SVG-enabled browsers only)

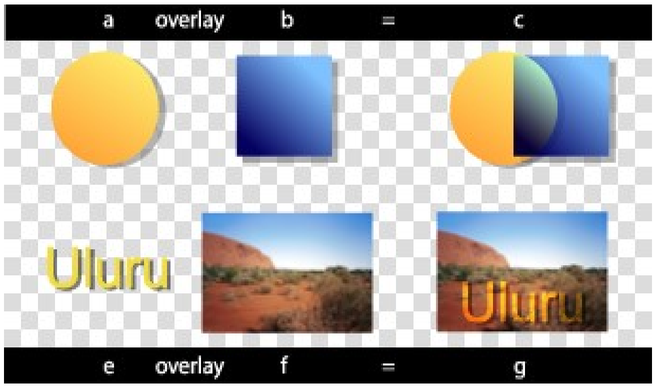
overlay

Multiplies or screens the colors, dependent on the destination color. Source colors overlay the destination whilst preserving its highlights and shadows. The destination color is not replaced, but is mixed with the source color to reflect the lightness or darkness of the destination.

```
if 2.Dc < Da
  f(Sc,Dc) = 2.Sc.Dc
otherwise
  f(Sc,Dc) = 1 - 2.(1 - Dc).(1 - Sc)
X         = 1
```

```
Y         = 1
Z         = 1

if 2.Dca < Da
  Dca' = 2.Sca.Dca + Sca.(1 - Da) + Dca.(1 - Sa)
otherwise
  Dca' = Sa.Da - 2.(Da - Dca).(Sa - Sca) + Sca.(1 - Da) + Dca.(1 - Sa)

Da' = Sa + Da - Sa.Da
```

The following diagram shows overlay compositing:



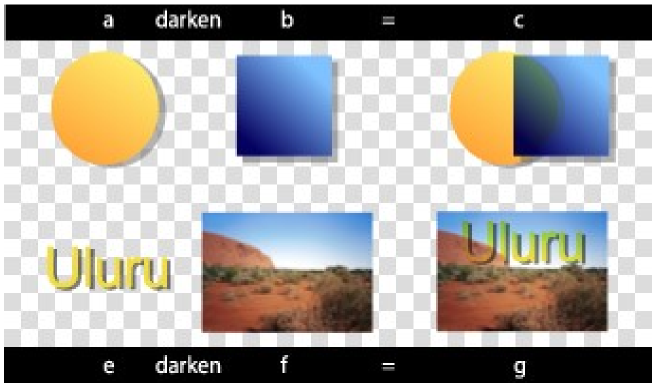
View this image as SVG (SVG-enabled browsers only)

darken

Selects the darker of the destination and source colors. The destination is replaced with the source when the source is darker, otherwise it is left unchanged.

```
f(Sc,Dc) = min(Sc,Dc)
X         = 1
Y         = 1
Z         = 1

Dca' = min(Sca.Da, Dca.Sa) + Sca.(1 - Da) + Dca.(1 - Sa)
Da'  = Sa + Da - Sa.Da

or

if Sca.Da < Dca.Sa
  src-over()
otherwise
  dst-over()
```

The following diagram shows darken compositing:



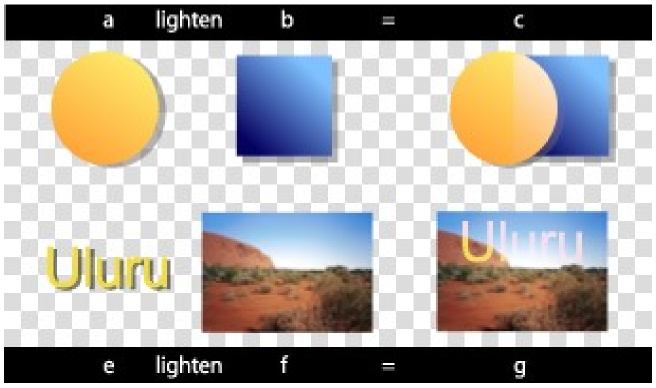
View this image as SVG (SVG-enabled browsers only)

lighten

Selects the lighter of the destination and source colors. The destination is replaced with the source when the source is lighter, otherwise it is left unchanged.

```
f(Sc,Dc)  = max(Sc,Dc)
X         = 1
Y         = 1
Z         = 1

Dca' = max(Sca.Da, Dca.Sa) + Sca.(1 - Da) + Dca.(1 - Sa)
Da'  = Sa + Da - Sa.Da

or

if Sca.Da > Dca.Sa
  src-over()
otherwise
  dst-over()
```

The following diagram shows lighten compositing:



View this image as SVG (SVG-enabled browsers only)

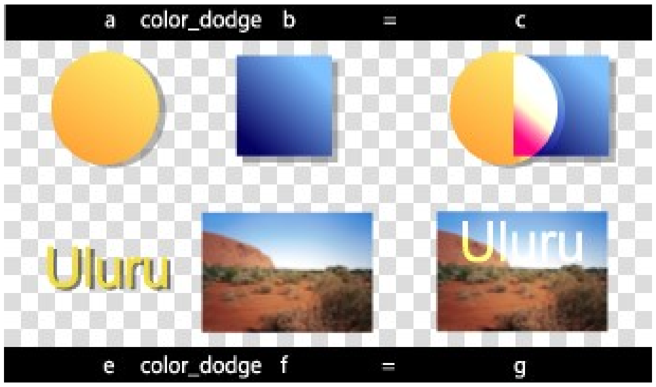
color-dodge

Brightens the destination color to reflect the source color. Painting with black produces no change.

```
if Sc + Dc >= 1
  f(Sc,Dc) = 1
otherwise
  f(Sc,Dc) = Dc.1/(1-Sc)
```

```
X         = 1
Y         = 1
Z         = 1

if Sca.Da + Dca.Sa >= Sa.Da
  Dca' = Sa.Da + Sca.(1 - Da) + Dca.(1 - Sa)
otherwise
  Dca' = Dca.Sa/(1-Sca/Sa) + Sca.(1 - Da) + Dca.(1 - Sa)

Da'  = Sa + Da - Sa.Da
```

The following diagram shows color-dodge compositing:



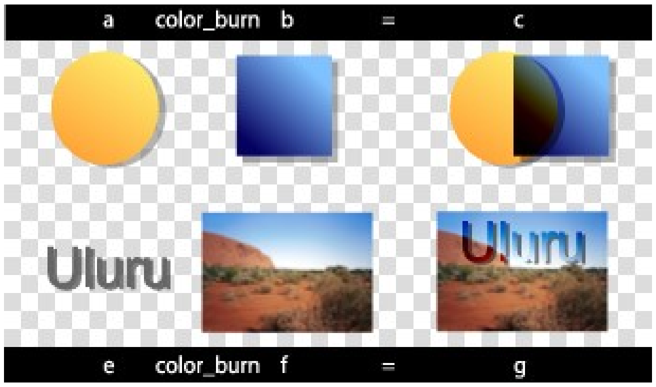
View this image as SVG (SVG-enabled browsers only)

color-burn

Darkens the destination color to reflect the source color. Painting with white produces no change.

```
if Sc + Dc <= 1
  f(Sc,Dc) = 0
otherwise
  f(Sc,Dc) = (Sc + Dc - 1)/Sc
X         = 1
Y         = 1
Z         = 1

if Sca.Da + Dca.Sa <= Sa.Da
  Dca' = Sca.(1 - Da) + Dca.(1 - Sa)
otherwise
  Dca' = Sa.(Sca.Da + Dca.Sa - Sa.Da)/Sca + Sca.(1 - Da) + Dca.(1 - Sa)

Da'  = Sa + Da - Sa.Da
```

The following diagram shows color-burn compositing:



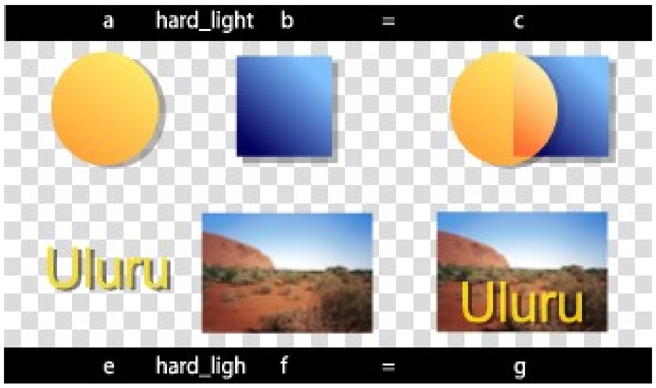
View this image as SVG (SVG-enabled browsers only)

hard-light

Multiplies or screens the colors, dependent on the source color value. If the source color is lighter than 0.5, the destination is lightened as if it were screened. If the source color is darker than 0.5, the destination is darkened, as if it were multiplied. The degree of lightening or darkening is proportional to the difference between the source color and 0.5. If it is equal to 0.5 the destination is unchanged. Painting with pure black or white produces black or white.

```
if 2.Sc < 1
   f(Sc,Dc) = 2.Sc.Dc
otherwise
   f(Sc,Dc) = 1 - 2.(1 - Dc).(1 - Sc)
X         = 1
Y         = 1
Z         = 1

if 2.Sca < Sa
   Dca' = 2.Sca.Dca + Sca.(1 - Da) + Dca.(1 - Sa)
otherwise
   Dca' = Sa.Da - 2.(Da - Dca).(Sa - Sca) + Sca.(1 - Da) + Dca.(1 - Sa)

Da'  = Sa + Da - Sa.Da
```

The following diagram shows hard-light compositing:



View this image as SVG (SVG-enabled browsers only)

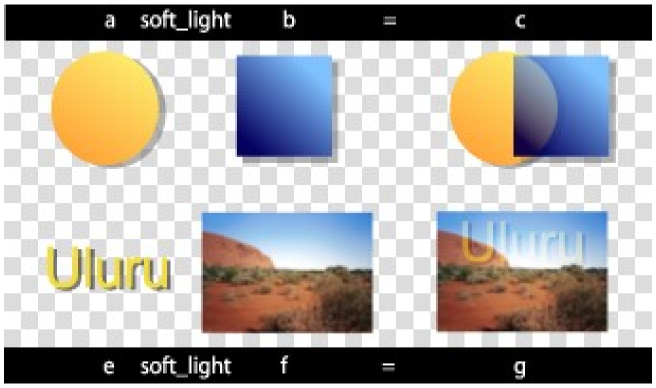
soft-light

Darkens or lightens the colors, dependent on the source color value. If the source color is lighter than 0.5, the destination is lightened. If the source color is darker than 0.5, the destination is darkened, as if it were burned in. The degree of darkening or lightening is proportional to the difference between the source color and 0.5. If it is equal to 0.5, the destination is unchanged. Painting with pure black or white produces a distinctly darker or lighter area, but does not result in pure black or white.

```
if 2.Sc < 1
   f(Sc,Dc) = Dc.(1 - (1 - Dc).(2.Sc - 1))
otherwise if 8.Dc <= 1
   f(Sc,Dc) = Dc.(1 - (1 - Dc).(2.Sc - 1).(3 - 8.Dc))
otherwise
   f(Sc,Dc) = (Dc + (Dc^(0.5) - Dc).(2.Sc - 1))
X         = 1
Y         = 1
Z         = 1
```

```
if 2.Sca < Sa
   Dca' = Dca.(Sa - (1 - Dca/Da).(2.Sca - Sa)) + Sca.(1 - Da) + Dca.(1 - Sa)
otherwise if 8.Dca <= Da
   Dca' = Dca.(Sa - (1 - Dca/Da).(2.Sca - Sa).(3 - 8.Dca/Da)) + Sca.(1 - Da) + Dca.(1
otherwise
   Dca' = (Dca.Sa + ((Dca/Da)^(0.5).Da - Dca).(2.Sca - Sa)) + Sca.(1 - Da) + Dca.(1 -

Da'  = Sa + Da - Sa.Da
```

The following diagram shows soft-light compositing:



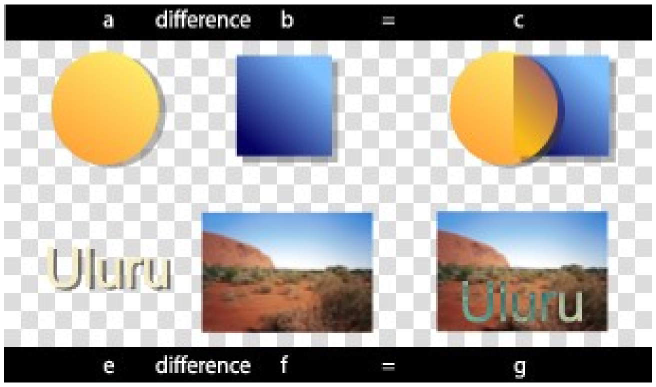
View this image as SVG (SVG-enabled browsers only)

difference

Subtracts the darker of the two constituent colors from the lighter. Painting with white inverts the destination color. Painting with black produces no change.

```
f(Sc,Dc) = abs(Dc - Sc)
X        = 1
Y        = 1
Z        = 1

Dca' = abs(Dca.Sa - Sca.Da) + Sca.(1 - Da) + Dca.(1 - Sa)
     = Sca + Dca - 2.min(Sca.Da, Dca.Sa)
Da'  = Sa + Da - Sa.Da
```

The following diagram shows difference compositing:



View this image as SVG (SVG-enabled browsers only)

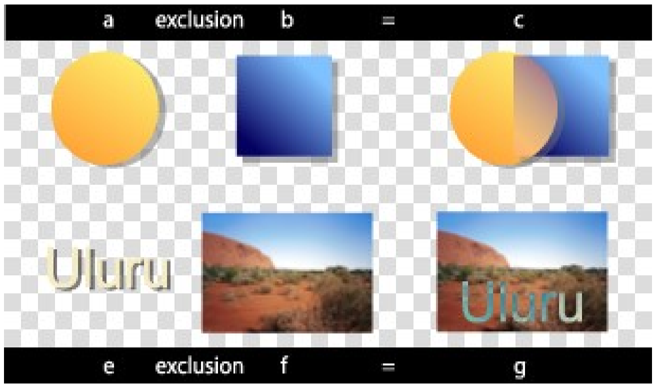
exclusion

Produces an effect similar to that of 'difference', but appears as lower contrast. Painting with white inverts the destination color. Painting with black produces no change.

```
f(Sc,Dc) = (Sc + Dc - 2.Sc.Dc)
X        = 1
Y        = 1
Z        = 1

Dca' = (Sca.Da + Dca.Sa - 2.Sca.Dca) + Sca.(1 - Da) + Dca.(1 - Sa)
Da'  = Sa + Da - Sa.Da
```

These equations are approximations which are under review. Final equations may differ from those presented here.

The following diagram shows exclusion compositing:



View this image as SVG (SVG-enabled browsers only)

10.2 Drawing Order

Previous drafts of SVG 1.2 mentioned the possibility of a z-index property to allow separation of document order from drawing order. After long consultations with implementors and content developers, the SVG Working Group has decided not to add the feature. Instead, SVG 1.2 adds a technique to enable multiple layers or canvases that are displayed above the regular SVG canvas. This new feature is described below.

It is possible to simulate z-index the moment either using SMIL animation and multiple use elements, or through scripting (moving an element toward the end of the document). However, both can place restrictions on document structure, and have limitations due to property inheritance.

In the next draft there will be a feature which enables the author to place graphics above the canvas.

10.3 Constrained Transformations

There are many situations in which the user wishes to have greater control over the coordinate system used by an object. An example is a legend on a map, which should retain the same position and size regardless of the transformation applied to user space by the user agent, such as zoom and pan.

SVG 1.2 extends the syntax of the transform attribute to provide a set of constrained transforms.

The new type of transform definition is:

- **ref(target [x y])**, which specifies a transformation matrix that converts the object's coordinate system into a referenced coordinate system. If **x** and **y** are not provided, they are assumed to be zero.

The value of 'target' can either be a local id URI reference or the special keyword 'host'.

The new transformation definition behaves in the same manner as the existing definitions in that it can be expressed as a transformation matrix which forms part of the coordinate system evaluation. However, the transformation matrix corresponding to the 'ref' definition depends on the current state of the document, rather than simply the definition parameters.

A value of 'ref(target)' evaluates to the matrix that is the inverse of the current user space matrix multiplied by the user space matrix of the referenced target element. The resulting effect is that the coordinate space of the transformed element becomes the coordinate space of the referenced element.

A value of 'ref(target, x, y)' is equivalent to 'ref(target)' with an additional translation so that the point (0,0) in the resulting coordinate space is mapped to the point (x,y) in the initial coordinate space.

When the target is the 'host' keyword, then the referenced element is found by starting from the current element and moving up in the tree until an element with a transform-host property set to 'true' is found. If no such element is found then:

- if the tree is referenced by an element from the SVG language, then the search continues from the referencing element
- otherwise, there if no referenced element. Instead, the topmost element's initial viewport coordinate space, before zoom, pan or viewBox transformations are applied, is used as the host coordinate space.

The following example shows text which does not move or scale on pan or zoom, regardless of the transform at element "a":

```
<svg>
   <g id="a" transform="...">
       <text transform="ref(host)">Text</text>
   </g>
</svg>
```

The next example shows text which moves along with the point (20,30) in the user space, but does not scale:

```
<svg>
   <g id="a" transform="...">
       <text transform="ref(host,20,30)">Text</text>
   </g>
</svg>
```

10.3.1 The transform-host property

The transform-host property defines an element to act as the default transformation host for its children or referenced content.

transform-host

Value:	true | false
Initial:	false
Applies to:	container elements, use, image, feImage
Inherited:	no
Percentages:	N/A

Media:	visual
Animatable:	yes

The following example shows an image that can embed any of the previous constrained transform examples ensuring they all transform correctly in relation to the image element.

```
<svg>
    <g id="computer" transform="...">
       <image id="computer_screen" xlink:href="..." transform-host="true"/>
   </g>
</svg>
```

10.4 Loading images

The SVG 1.1 specification does not make it clear when an image that is not being displayed should be loaded. In SVG 1.2, a user agent is not required to load image data for an image that is not displayed (e.g. is is outside the initial document viewport).

However, it should be noted that this may cause a delay when an image becomes visible for the first time.

In the case where an author wants to suggest that the user agent load image data before it is displayed, they should use the prefetch element.

11 Painting Enhancements

11.1 The solidColor Element

The solidColor element is a paint server that provides a single color with opacity. It can be referenced like the other paint servers (gradients and patterns).

```
<xs:element name="solidColor">
  <xs:complexType>
    <xs:attributeGroup ref="PresentationAttrs"/>
    <xs:attributeGroup ref="StyleAttrs"/>
  </xs:complexType>
</xs:element>
```

The solid-color property indicates what color to use for this solidColor element. The keyword currentColor and ICC colors can be specified in the same manner as within a <paint> specification for the fill and stroke properties.

solid-color

Value:	currentColor | <color> [icc-color(<name> [, <icccolorvalue>]*)] | inherit
Initial:	black
Applies to:	solidColor elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The solid-opacity property defines the opacity of a given solid color.

solid-opacity

Value:	<alphavalue> | inherit

Initial:	1
Applies to:	solidColor elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

11.2 Alpha values in color property values

SVG 1.2 supports the CSS3 Color Module rgba() value syntax for color properties. This provides an opacity value for a solid color value. This opacity is multiplied into the processing of SVG colors before the other opacity values (such as stop-opacity, fill and stroke opacity and the opacity property).

11.3 Background Fill Property

SVG 1.2 will enable the author to specify a paint server which will be used to fill the background of any element that creates a viewport, such as the root svg element. In SVG 1.2, the referenced paint server is restricted to being a solid color. Future versions of SVG may allow arbitrary paint servers, such as gradients and patterns.

The background-fill property defines the paint used to fill the viewport created by a particular element.

background-fill

Value:	<paint>
Initial:	none
Applies to:	viewport-creating elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

It is an error to reference a fill that is not a solid color operation. Below is an example of background-fill.

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     background-fill="red">

  <!-- Everything here has a red background -->

  <!-- This rectangle is not filled, so the red background
        will show through -->
  <rect x="20" y="20" width="100" height="100"
        fill="none" stroke="black"/>

  <svg x="40" y="100" width="200" height="200"
       background-fill="green">

    <!-- Everything here has a green background -->

  </svg>

</svg>
```

11.4 Inheritance into the shadow tree

The shadowInherit property applies to elements that establish shadow trees and controls property inheritance in those shadow trees. In SVG 1.0 and 1.1, this behavior was fixed depending on the element name. This property regularizes control over the inheritance method and gives more flexibility to content creators.

shadowInherit

Value:	onDefine | onUse | none | inherit
Initial:	onDefine
Applies to:	all elements that establish shadow trees
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	no

onDefine
: Properties inherit into the shadow tree at their point of definition, in other words from the element that defines the shadow tree.

  In SVG 1.0 and 1.1, for example, marker elements behave like this. It is easy to make red markers that are used on multiple paths, and difficult to make markers that are the color of the path on which they are used. Similarly gradient elements behave like this; it is difficult to make a gradient one of whose stops is the currentColor for example.

onUse
: Properties inherit into the shadow tree at their point of use, in other words from the element that generates the shadow tree.

  In SVG 1.0 and 1.1, for example, symbols behave like this. It is easy to make symbols that are used in multiple places, and inherit from the use element that references them.

none
: There is no inheritance into the shadow tree. All properties on the root element of the shadow tree are set to their initial values, as if the shadow tree were in a separate document. This allows SVG content to be created and then re-used without risk of styling changes from the surrounding context.

inherit
: (This is a useless value but we need to define what happens). If the parent element is an element that establishes shadow trees then the value is that of the shadowInherit property on the parent element. Otherwise, it is the same as onDefine.

The User Agent default stylesheet for SVG 1.2 user agents, to give SVG 1.0/1.1 compatible styling, includes the following rules:

```
symbol { shadowInherit: onUse; }
image, feImage { shadowInherit: none; }
```

11.5 Using device colors

Certain print applications can improve printing quality by specifying colors by name or in an alternative color format. This often is referred to the use of 'spot' colors, device colors or inks, and usually means that a particular ink will be used for the color when it is printed. Furthermore, there are applications in the printing press industry where presses can be set up with different inks for different jobs. This means that the content creator will need to create content tailored to the particular press setup in order to obtain the best results.

The deviceColor element can be used to indicate an alternative color for a particular paint. This element will be mostly used in closed workflows, since the names of the inks and the parameters (percentages of each ink's color components) rarely have meaning outside the domain of the target device.

```
<xs:element name="deviceColor">
  <xs:complexType>
    <xs:attribute ref="href" use="required"
        namespace="http://www.w3.org/1999/xlink"/>
    <xs:attribute ref="name" use="required" type="string"/>
    <xs:anyAttribute namespace="##any" processContents="skip"/>
  </xs:complexType>
</xs:element>
```

xlink:href

A URI used to identify the device-specific information included in this element. If the User Agent does not recognize the URI (ie. is not able to recognize the particular device parameters) then the element should be ignored and should not be part of the rendering process.

Animatable: no

name

The name of this device-specific color information. The name attribute is used within the device-color specification within <paint> to reference this deviceColor element.

Animatable: no

The deviceColor element uses attributes from external namespaces to define the device specific properties that are to be used when the deviceColor is referenced from a <paint>.

The following example illustrates the use of deviceColor. There are two things to note:

1. The deviceColor element describes device specific setup information.
2. The device-color keyword is used as an alternative <paint> specification, achieving the desired <paint> when the output is the named device (or when the User Agent is able to understand the device specific information).

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:xlink="http://www.w3.org/1999/xlink"
     xmlns:ecpi="http://www.example.com/press/inks">

  <defs>
     <!-- describe a particular output device -->
     <deviceColor name="device-inks"
                  xlink:href="http://www.example.com/pressInks"
             ecpi:value="Cyan, Magenta, Yellow, Black, Silver, Gray, Green"/>
  </defs>

  <text x="100" y="150" font-family="Verdana" font-size="35"
        fill="rgb(22,33,44) device-color(device-inks, 11,55,66,77,0,0,88)" >

     Hello, out there

  </text>

</svg>
```

In the example above, a supplemental attribute, value, from a private namespace has been added. This example value attribute provides the definitions of colors or inks to be interpreted in the context of the URI specified. It is in a private namespace so that content and context authors can use any understood format to convey the necessary information. When the particular deviceColor element is referenced later by a device-color keyword specification, it is generally expected that the number of parameters following the name reference (1st parameter) in the function-like representation for the value of device-color alternate in a fill or stroke attribute (for example) will have an understood one-to-one correspondence with the information specified for the value attribute in the the deviceColor element. The interpretation of the parameters is implied specifically by the context set by the URI.

11.5.1 The device-color keyword

The device-color keyword for specifying device specific <paint> colors is to be used only by those agents that understand the full meaning of the context set by the URI in the referred to DeviceColor element. The keyword can only be used with a corresponding color definition, such as a color keyword or RGB definition. The color definition, with ICC Color specification when present, is used if the agent does not understand the rendering context implied by the referenced device-color URI. The priority of the use of color specifications are as follows: device-color if understood, color-profile if present and understood and finally the sRGB specification.

The first parameter in the function like representation device-color must be the name for a defined deviceColor element, in a manner similar to color-profile. The remainder of the parameters are interpreted entirely in light of the information provided in the deviceColor element. There is a correspondence between the parameters after the name in the functional representation for device-color and the external attributes on the referenced deviceColor. In the example above, the interpretation of the values meaning (ink volume to use, percent of total ink volume, or whatever) is strictly in the context of the specification or convention implied by the URI in the referenced deviceColor element.

Addition of this keyword will modify the definition of the <paint> type. For this draft, we just include the definition of the keyword. Future drafts will specify the new <paint> type in full.

11.5.2 DOM Interface

Interface SVGDeviceColorElement provides access to the deviceColor element.

IDL Definition

```
interface SVGDeviceColorElement : SVGURIReference {
  readonly attribute DOMString name; // raises DOMException on setting
};
```

Attributes

readonly DOMString name
    Corresponds to the attribute 'name' on the given element

11.6 Controlling the rendering color space

SVG 1.2 adds a new property to give increased control over the color space used for rendering.

The SVG Working Group are considering removing this new feature from SVG 1.2 due to lack of interest. If it is removed it may be considered for future versions of the SVG language. If you have a need for this feature in the short term, please give feedback to the SVG Working Group. The same applies if you have implemented the feature.

11.6.1 The rendering-color-space property

The rendering-color-space property defines the color space that an element's rendering operations will take place in. Conceptually this involves the creation of an offscreen buffer with color space is defined by the ICC profile referenced by the property. All fill/stroke/gradient/pattern specifications must be converted to this color space before elements are rendered. Images and the results of filtering must be color converted, when required, to the specified color space before being composited. After the object/group is rendered the offscreen image must be converted to the color space defined by the rendering-color-space property on the object/group's parent before being composited into the parent's offscreen buffer.

The ICC profile referenced must provide forward and reverse conversion, as the implementation will need to convert to and from the specified color space; most ICC profiles provide both conversions. To limit the burden on implementors only three channel ICC profiles are required to be supported. In cases where the specified ICC profile can not be used (such as not being available, or because it has more than three channels of output) the implementation must use the rendering-color-space specification from the first ancestor that has a usable profile associated (i.e. it is as if a value was not provided for this property for this element).

Note that standard SVG compositing rules are used. As a consequence highly non-linear color spaces (such as HSV) or non-orthogonal color spaces (such as CMYK) may give unintuitive results when blending colors.

rendering-color-space

Value:	auto | sRGB | linearRGB | <name> | <uri> |inherit
Initial:	auto
Applies to:	container elements and graphical elements
Inherited:	yes
Percentages:	N/A
Media:	visual
Animatable:	yes

auto
: The user agent must defer to the 'color-interpolation' property.

sRGB
: Specifies that the sRGB color space is to be used for rendering.

linearRGB
: Specifies that the linear sRGB color space is to be used for rendering.

<name>
: A name corresponding to a defined color profile that is in the user agent's color profile description database. The user agent searches the color profile description database for a color profile description entry whose name descriptor matches <name> and uses the last matching entry that is found. If no match is found then it is as if 'sRGB' were specified.

<uri>
: A URI reference to the source color profile to use for rendering.

The color-interpolation property on gradients and color-interpolation-filters property on filter primitives are also extended to support <name> and <uri> references. This enables gradients and filters where interpolation occurs in an alternate color space. When the gradient is rendered the colors must be converted to the rendering-color-space of the object the gradient is applied to (consistent with the current definition of color-interpolation).

The color-interpolation property on graphics elements will be deprecated. The current definition of color-interpolation states that when the property is set on an element it controls what color space is used when the child is composited with it's parent.

The problem with this definition is that it implicitly requires converting the content already rendered into the parents buffer to the color space specified by color-interpolation for compositing with the child. This made sense when the only supported color spaces were sRGB and linear sRGB, because presumably the compositing code would perform the conversion, composite and convert back all at once, thus preserving the fidelity of the parent buffer. However it would be extremely difficult and computationally expensive for implementations to do this for arbitrary ICC color spaces.

Given this definition, for the use of the color-interpolation property to be make sense, the property would generally have to be set on all the children of a grouping element, but not be set on the grouping element. This would allow an implementation to composite all the children in the desired color space, and only convert to the 'parent' color space at the end of the group. However having to set a property on all the children but not on the parent would be extremely fragile as well as error prone for generators of SVG content.

Thus the SVG working group has decided that rendering-color-space should replace color-interpolation for use on graphics elements, it allows a clearer expression of the authors intent, and makes costly mistakes (both in speed and quality) less likely.

The user agent will go into error if the value of rendering-color-space is anything but 'auto' when color-interpolation has a value of 'linearRGB'. If color-interpolation is removed a future version of the specification the 'auto' value for rendering-color-space will be defined to mean 'sRGB'.

Should this property apply (or not) to implementations with more than 3 channels?

11.7 Filter Region extensions

In SVG 1.1, a filter defines the area upon which it applies. This makes it difficult to develop a generic filter that can be applied to arbitrary graphics, since the filter must define a large enough area to cover any graphical object to which it is applied. An example of this is a generic "drop shadow" filter, which is commonly specified as a combination of a Gaussian blur feGuassianBlur) that is offset feOffset) and then composed feComposite) with the original source graphic. Since the shadow has to extend beyond the original graphic's boundaries, the filter must be defined to have a larger area than the original graphic. Overestimating this margin has a negative effect on performance, since the complex filter operation has to touch a larger amount of user space (ie. pixels).

In order to solve this problem, SVG 1.2 adds margins to the filter and filter primitive elements. These margins are added to the filter region, once any conversion of the filter region from object space into user space has been made.

In particular, the filterMarginsUnits, filterPrimitiveMarginsUnits, dx, dy, dw and dh are added to the filter element. The filterMarginsUnits specifies the coordinate space of the new margin attributes, which are used to increase or decrease the filter element's x, y, width and height attributes (once they have been calculated). The filterPrimitiveMarginsUnits specifies the units for the new margin attributes on the filter primitives, also named dx, dy, dw, dh. These margins attribute override those set on the parent filter element.

An example of the new attributes, which defines a generic dropShadow filter:

```
<filter id="dropShadow" x="0" y="0" width="1" height="1"
          filterMarginsUnits="userSpaceOnUse"
          dx="0" dy="0" dw="5" dh="5" >
```

```
        <feGaussianBlur stdDeviation="2" in="SourceAlpha" />
        <feOffset dx="2" />
        <feMerge>
             <feMergeNode />
             <feMergeNode in="SourceGraphic" />
        </feMerge>
</filter>
```

In the above example, the filter region by default covers the entire bounds of the object (which is not enough to show the shadow). Adding the new margins extends the width and height by 5 user units each, which is always enough to display the blur (which has a standard deviation of 2 user units) and offset (which is another 2 units).

11.8 Hinting SVG Fonts

When displaying text on low-resolution devices or at very small sizes on higher-resolution devices it is common for a User Agent to use what is called a 'hinted' version of a scalable font. Many popular font formats, such as TrueType and Postscript, allow hinting. Typically this is a set of instructions to the text layout system that, when followed, will produce optimum legibility. This could include instructions on placing parts of the glyph on pixel boundaries or instructions on keeping the width of adjacent glyph stems constant.

The font format included in SVG 1.1 does not allow hinting. This is seen as a shortcoming in situations where the available resolution is insufficient to display the glyphs well, and where legibility of the text is considered more important than preserving the typographic color of the font used. This has meant that authors are embedding fonts in other formats inside SVG documents.

SVG 1.2 plans to add hinting as an optional feature on SVG fonts in order to give authors the choice of a pure SVG solution. The main requirements are that the hinting technology be declarative, work on non axis aligned text (eg. rotated text) and available royalty-free to SVG implementations. The most likely solution is a variation of Postscript Type 1 hinting.

11.9 Prefetching resources

In SVG 1.1 it is not clear when an user agent should begin downloading references media, particularly when the media is not used in the initial document state (e.g. it is offscreen or hidden). SVG 1.2 does not require user agents to download referenced media that is not visual at the time the document is loaded. This means there may be a pause to download the file the first time a piece of media is displayed. More advanced user agents may wish to predict that particular media streams will be needed and therefore download them in anticipation.

SVG 1.2 also adds functionality (adapted from Section 4.4 of SMIL 2.0 — The PrefetchControl Module) to allow content developers to suggest fetching content from the server before it is needed to improve the rendering performance of the document.

11.9.1 The prefetch element

The prefetch element will give a suggestion or hint to a user agent that a media resource will be used in the future and the author would like part or all of the resource fetched ahead of time to make the document playback smoother. User-agents can ignore prefetch elements, though doing so may cause an interruption in the document playback when the resource is needed. It gives authoring tools or savvy authors the ability to schedule retrieval of resources when they think that there is available bandwidth or time to do it.

The prefetch element is a particular type of animation element. The full details of how prefetch fits into the animation model of SVG is not described in this draft. As SVG 1.2 adds more of the planned SMIL features, such as video, audio, par and seq, the behavior of the prefetch element will be described in full.

```
<xs:element name="prefetch">
  <xs:complexType>
    <xs:attribute ref="href" use="required"
        namespace="http://www.w3.org/1999/xlink"/>
    <xs:attributeGroup ref="StdAttrs"/>
    <xs:attribute ref="mediaSize"/>
    <xs:attribute ref="mediaTime"/>
    <xs:attribute ref="bandwidth"/>
  </xs:complexType>
</xs:element>
```

mediaSize = " <number> | <percentage>"
: Defines how much of the resource to fetch as a function of the file size of the resource. To fetch the entire resource without knowing its size, specify 100%. The default is 100%.

mediaTime = " <clock> | <percentage>"
: Defines how much of the resource to fetch as a function of the duration of the resource. To fetch the entire resource without knowing its duration, specify 100%. The default is 100%. For discrete media (non-time based media like image/png) using this attribute causes the entire resource to be fetched.

bandwidth = " <number> | <percentage>"
: Defines how much network bandwidth the user agent should use when doing the prefetch. To use all that is available, specify 100%. The default is 100%.

Any attribute with a value of "0%" is ignored and treated as if the attribute wasn't specified.

If both mediaSize and mediaTime are specified, mediaSize is used and mediaTime is ignored.

Below is an example of the prefetch element:

```
<svg width="400" height="300" version="1.2"
     xmlns="http://www.w3.org/2000/svg"
     xmlns:xlink="http://www.w3.org/1999/xlink">
  <desc>
     Prefetch the large images before starting the animation
     if possible.
  </desc>

  <defs>
    <prefetch id="pf1" xlink:href="http://www.example.com/images/huge1.png"/>
    <prefetch id="pf2" xlink:href="http://www.example.com/images/huge2.png"/>
    <prefetch id="pf3" xlink:href="http://www.example.com/images/huge3.png"/>
  </defs>

  <image x="0" y="0" width="400" height="300"
     xlink:href="http://www.example.com/images/huge1.png"
     display="none">

     <set attributeName="display" to="inline" begin="10s"/>

     <animate attributeName="xlink:href" values="
            http://www.example.com/images/huge1.png;
            http://www.example.com/images/huge2.png;
            http://www.example.com/images/huge3.png"
         begin="15s" dur="30s"/>
  </image>

</svg>
```

11.10 Referencing external stylesheets

SVG 1.2 adds the xlink:href attribute to the style element, allowing the reference of external stylesheets. The attribute behaves in the same way as the corresponding attribute on the script element.

11.11 Increased switch availability

SVG 1.2 will allow the switch element to be a child of more elements — potentially all elements.

The full details of this feature will be available once the complete draft schema is created.

11.12 Overlaying graphics

There are many cases when it is necessary for graphical objects to be drawn above the canvas.

11.12.1 The overlay property

The overlay property controls how an element's canvas is composited into the document canvas.

overlay

Value:	'top' | 'none'
Initial:	'none'
Applies to:	svg element
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The SVG 1.1 specification says:

Grouping elements such as the g have the effect of producing a temporary separate canvas initialized to transparent black onto which child elements are painted. Upon the completion of the group, any filter effects specified for the group are applied to create a modified temporary canvas. The modified temporary canvas is composited into the background, taking into account any group-level masking and opacity settings on the group.

For elements that have the overlay property is set to "top" the element's "temporary separate canvas" is not composited to the background as usual. Instead that "temporary separate canvas" is set aside. In other words, the element gets drawn to its canvas, but that canvas is not drawn into to the background yet (and instead drawn later in the whole document's compositing process). Such canvases are commonly referred as overlays, hence the name.

11.12.2 The overlay-host property

The overlay-host property affects how all "temporary separate canvases" of this element descendants are composited.

overlay-host

Value:	'true' | 'false'
Initial:	'false'
Applies to:	svg element

Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

If the value of overlay-host is true, then after the "modified temporary canvas is composited into the background" for this svg element, all "temporary separate canvases" that were set aside in the course of this element's drawing are composited into the background. In other words, overlay host draws all the overlays on top of the other content of the element. Overlays are drawn in the order they were created.

11.13 Modifications to cursors

11.13.1 The cursor property

In SVG 1.2, the cursor property adds a new value "progress", as defined in CSS 2.1. It is often rendered as a spinning beach ball, or an arrow with a watch or hourglass.

11.13.2 Inline cursor content

SVG 1.2 allows cursor appearance to be defined using SVG content. The following is a replacement for the SVG 1.1 section on the cursor element:

The cursor element can be used to define a platform-independent custom cursor. A recommended approach for defining a platform-independent custom cursor is through a cursor element with either PNG [PNG01] or SVG to define cursor's image and identify the exact position within the image which is the pointer position (i.e., the hot spot). If the cursor element has an xlink:href attribute, it is assumed that cursor shape is defined through an external image, otherwise cursor element's content is drawn into a separate canvas and the result is used as cursor's image.

If a bitmap image is used, the PNG format is recommended because it supports the ability to define a transparency mask via an alpha channel. If a different image format is used, this format should support the definition of a transparency mask (two options: provide an explicit alpha channel or use a particular pixel color to indicate transparency). If the transparency mask can be determined, the mask defines the shape of the cursor; otherwise, the cursor is an opaque rectangle. Typically, the other pixel information (e.g., the R, G and B channels) defines the colors for those parts of the cursor which are not masked out. Note that cursors usually contain at least two colors so that the cursor can be visible over most backgrounds.

If xlink:href attribute is specified the width, height, viewBox and preserveAspectRatio attributes are meaningless and must not be used.

If the cursor image is defined through SVG, the rules are the following:

- the initial state of the cursor image canvas is transparent blank
- the cursor element creates its own viewport to draw the cursor content and allows regular viewport attributes (width, height, viewBox and preserveAspectRatio). The overflow property does not have any effect because nothing can be drawn outside of the cusor's image dimensions.
- animations and DOM modifications are allowed in the cursor element and should be visible.
- if a viewBox is used, the hot spot is defined in terms of the cursor's element children (i.e. after application of the viewBox)

Attribute definitions:

x = " <coordinate>"
: The x-coordinate of the position in the cursor's coordinate system which represents the precise position that is being pointed to. If the attribute is not specified, the effect is as if a value of "0" were specified. Animatable: yes.

y = " <coordinate>"
: The y-coordinate of the position in the cursor's coordinate system which represents the precise position that is being pointed to. If the attribute is not specified, the effect is as if a value of "0" were specified. Animatable: yes.

xlink:href = " <uri>"
: A URI reference to the file or element which provides the image of the cursor. Animatable: yes.

width = " <length>"
: The horizontal dimension of the cursor image if the cursor is defined through SVG. Animatable: yes

height = " <length>"
: The vertical dimension of the cursor image if the cursor is defined through SVG. Animatable: yes

preserveAspectRatio
: As usual

viewBox
: As usual

11.14 Highlighting

SVG 1.1 allows a target object to be denoted, either with a view element or with a viewTarget as part of an SVG view specification in a fragment identifier. The target object(s) are to be highlighted.

Just checking, the spec allows multiple viewTarget s in a fragment identifier, yes? http://www.w3.org/TR/SVG11/linking.html#SVGFragmentIdentifiers

While there are some common highlighting strategies, e.g. a thick red outline for black and white schematics, in the fully general case there is no one presentation of highlighting that is guaranteed to be visible in all cases. An element might already have a thick red outline, for example. Approaches using filter effects for color inversion can also be non-obvious in certain cases.

Accordingly, the SVG 1.1 description: "Indicates the target object associated with the view. If provided, then the target element(s) will be highlighted." does not specify how the highlighting is to be achieved or even if the highlighting must be visually distinct from the non-highlighted case.

In SVG 1.2, highlighting in a conforming SVG viewer must be visually detectable. The default rendering is left application dependent, it just has to be visible. Since content creators are in a much better position to decide on an appropriate visual effect for their graphics, a dynamic pseudo-class ':highlight' is provided in SVG 1.2. It matches the target element(s) that are to be highlighted. Appropriate styling can thus be specified by the author.

```
:highlight { stroke-width: 5; stroke-color: red }
#map .country:highlight {filter: url(#DropShadowBehind)}
```

The first example applies a thick red stroke to elements that are highlighted. The second applies a filter effect, but only to elements of class "country" which are descendents of the element with id="map".

The SVG 1.2 vector effects have a nice synergy with highlighting, since they allow (for example) multiple strokes to be applied to an element.

```
:highlight { vector-effect: url(#ThickRedSecondStroke) }
```

What happens if the target object is a group, a hyperlink, or some other container object which does not itself have a visual representation? Suggested resolution: inherited properties have their usual effect on the children.

11.15 More rendering hints

There exist cases where a user agent could achieve better performance if it were able to cache an offscreen buffer for a particular group or element. An example of such a use case are commonly called sprites.

SVG 1.2 adds three new properties that provide rendering hints to the user agent.

Should these have prefixes? The names are quite generic.

11.15.1 The cache property

The cache property suggests how much resources should be allocated to dynamic update.

cache

Value:	'true' | 'false' | 'auto'
Initial:	'auto'
Applies to:	graphical elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The value 'true' means that the element is expected to be redrawn often. The user agent may be able to assign extra resources in order to increase the rendering performance.

The value 'false' means that the element is not expected to be redrawn often. The user agent may be able to conserve resources that it normally allocated to redrawing.

The default value 'auto' means that the user agent is expected to use a reasonable compromise between speed of redraw and resource allocation.

11.15.2 The static property

The static property suggests whether or not an element is expected to be modified often.

static

Value:	'true' | 'false' | 'auto'
Initial:	'auto'
Applies to:	graphical elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The value 'false' means that the element is expected to be modified often.

The value 'true' means that the element is not expected to be modified often. This suggests that user agent may be able to allocate resources, such as an offscreen buffer, that would allow increased performance in redraw. It does not mean that the element will never change. If an element is modified when static has the value 'true', then redraw might have reduced performance.

The default value 'auto' means that the user agent is expected to use a reasonable compromise between speed of update and resource allocation.

11.15.3 The snap property

The snap property suggests whether or not an element is expected to be displayed in many places and to appear close to identical in each display.

snap

Value:	'true' | 'false' | 'auto'
Initial:	'auto'
Applies to:	graphical elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The value 'false' means that the element is not expected to be displayed in many locations, or that it is not required to look identical in every location.

The value 'true' means that the element is expected to be rendered in many places and different instances are expected to look as close as possible if all rendering parameters are the same and the user space transformation matrices differ only in the translation component. A typical use of this would be a symbol on a map. A user agent could choose to implement this hint by applying an additional translation to user space before drawing in order to align the user space with device pixels.

The default value 'auto' means that the user agent is expected to use a reasonable compromise between the two values above.

12 Alternate content based on display resolutions

An image may be placed at any location in userspace, and be subject to any set of affine transformations. In many cases, the resolution at which a raster image is rendered, whether to screen or another device, may not be a good match to the resolution of the image itself. For example, it is not efficient to load a 4000 by 4000 pixel image to be eventually rendered in a 10 pixel by 10 pixel region if an appropriate thumbnail was available at that size.

For this reason, SVG 1.2 will add enhancements to images which will allow multiple resources to be used for a single image. The choice of resource is governed by the output resolution.

The current proposal is to do this by extending the test attributes of the switch element. Below is an example:

```
<svg width="400" height="400">
      <g id="backgroundLayer">
          ...
      </g>
      <switch>
          <!-- Only show if 10 pixels (or more) make a -->
          <!-- user unit (very zoomed in)              -->
```

```
        <g id="veryDetailed" min-unit-scale="10">
              ...
        </g>


        <!-- Only show for 1-10 pixels in a user unit -->
        <!-- (somewhat zoomed in)                    -->
        <g id="somewhatDetailed"
           min-unit-scale="1" max-unit-scale="10">
              ...
        </g>
        <!-- Show for 1 pixel and down (zoom out)-->
        <g id="roughlyDetailed" max-unit-scale="1">
            ...
        </g>
    </switch>
</svg>
```

The following sections should be read as updating the equivalent sections from Chapter 5 of the SVG 1.1 Recommendation.

12.1 Conditional processing

12.1.1 Conditional processing overview

SVG contains a 'switch' element along with attributes requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale to provide an ability to specify alternate viewing depending on the capabilities of a given user agent, the user's language or the current transform between the user space and the device space

```
<xs:attribute ref="requiredFeatures"/>
<xs:attribute ref="requiredExtensions"/>
<xs:attribute ref="systemLanguage"/>
<xs:attribute ref="min-unit-scale"/>
<xs:attribute ref="max-unit-scale"/>
```

Attributes requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale act as tests and return either true or false results. The 'switch' renders the first of its children for which all of these attributes test true. If the given attribute is not specified, then a true value is assumed.

Similar to the 'display' property, conditional processing attributes only affect the direct rendering of elements and do not prevent elements from being successfully referenced by other elements (such as via a 'use').

In consequence:

- requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale attributes affect 'a', 'altGlyph', 'foreignObject', 'textPath', 'tref', and 'tspan' elements.
- requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale attributes will have no effect on 'mask', 'clipPath', and 'pattern' elements.
- requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale attributes do not apply to the 'defs', and 'cursor' elements because they are not part of the rendering tree.
- requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale attributes affect 'animate', 'animateColor', 'animateMotion', 'animateTransform', and 'set' elements. The SVG Working Group is discussing how to specify the impact of conditional processing on animations.

The 'switch' element evaluates the requiredFeatures, requiredExtensions, systemLanguage, min-unit-scale and max-unit-scale 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. If the child element is a container element such as a g, then the entire subtree is either processed/rendered or bypassed/not rendered. The test conditions must be evaluated whenever the corresponding context values change (e.g., the user language preferences) change and/or when the criteria change (e.g., the systemLanguage attribute) change.

Note that the values of properties 'display' and 'visibility' have no effect on 'switch' element processing. In particular, setting 'display' to none on a child of a 'switch' element has no effect on true/false testing associated with 'switch' element processing.

The evaluation of conditional content is dynamic. That is, if the document is modified then the conditional logic should be evaluated again.

12.2 The min-unit-scale and max-unit-scale attributes

The min-unit-scale and max-unit-scale attributes refer to the scale factor in the transform between the element's user space and the viewport space. These attributes are allowed to provide one or two values. If two values are provided then the first refers to the scale factor in the horizontal direction and the second value refers to the scale factor in the vertical direction. If one value is provided it is used for both the horizontal and vertical scale factors.

When implementations evaluate these attributes they should pay attention to the possibility that the content is being rendered in a filter using the filterRes attribute when calculating the scale factor from the current coordinate system to the viewport coordinate system.

If the scale factor from the current user coordinate system to the viewport coordinate system is greater than min-unit-scale, then the test evaluates to true. If the scale factor from the current user coordinate sytsem to the viewport coordinate system is smaller than max-unit-scale, then the test evaluates to true. Otherwise, the tests evaluate to false.

The min-unit-scale and max-unit-scale attributes are often used in conjunction with the 'switch' element. If the min-unit-scale and/or max-unit-scale attributes are used in other situations, then they represents a simple switch on the given element whether to render the element or not.

13 Vector Effects

13.1 The vectorEffect element

The vectorEffect element defines a transformation of a primitive shape's outline that happens before it is drawn. The transformation is described as a series of vector effect primitive processing nodes, where input(s) and the output of every node can be considered to be SVG path data. Any primitive shape or path element can reference a vector effect through the vector-effect property. Alternatively, vector effects can be used as a drawing element; in such case its input is considered to be empty (and the vePath element must be used to get input data).

The following is an extract of the schema that defines the vectorEffect element:

```
<xs:element name="vectorEffect">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="vePath" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veSetback" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veStrokePath" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veAffine" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veJoin" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veReverse" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veUnion" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veIntersect" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veExclude" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veFill" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veStroke" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veMarker" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="veMarkerPath" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute ref="vectorEffectUnits"/>
    <xs:attribute ref="compositing"/>
  </xs:complexType>
</xs:element>
```

The vectorEffectUnits attribute allows "userSpaceOnUse" or "objectBoundingBox" as values. The default is "userSpaceOnUse". The output of the last vector effect node is considered to be the result of the complete vector effect. That path is used when shape's outline is normally used (inside clipPath, for text flows and text on a path, and when referenced by a vePath element).

The compositing attribute allows "normal" or "knockout" as values. The value "normal" means that results of the individual fill operations are composited with each other as usual. The value "knockout" means that fill operations that go later in the pipeline override current values rather than mix with them.

This proposal includes some vector effect primitives that are still under discussion. In many cases there will have to be a implementation cost versus usage benefit decision. Please provide feedback on what primitives you would find the most useful.

This is the default vectorEffect that corresponds to the default SVG painting behavior:

```
<vectorEffect>
  <veFill/>
  <veStroke/>
  <veMarker/>
</vectorEffect>
```

13.2 Common vector effect primitive attributes

The following attributes are available on all vector effect primitives.

result = name of output

> The result attribute specifies the location, if necessary, of the output from the current vector effect primitive. It is analogous to the result attribute on filter effect primitives. If not specified, the value is empty, and the result is only passed to the following primitive. Animatable: no.

in = "SourcePath" | name of input
in2 = "SourcePath" | name of input

> The in and in2 attributes define the input locations for the current vector effect primitive. The value of "SourcePath" means that the outline of the shape that references this effect is used. Any other value refer to the output of another node within this vectorEffect identified by the value of its result attribute. If this attribute is omitted, for the first primitive the value "SourcePath" value is used, and the output of the previous primitive is used for all other nodes. The path used for "SourcePath"is always pre-

transformed to be in the correct coordinate space depending on the value of the vectorEffectUnits attribute value. Animatable: no

transform = <transform>
trandformPath = <transform>

The transform and transformPath attributes supply coordinate space transformations for some vector effect elements. The difference between them is that the transform attribute defines the coordinate space where a particular operation occurs, so that the input is transformed into to that coordinate space, the vector effect operation applied and then the inverse transform applied to the result. In contrast, transformPath is simply applied to the input of the particular operation. The default value is empty. Animatable: yes.

13.3 The veStrokePath element

```
<xs:element name="veStrokePath">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="transform"/>
    <xs:attribute ref="stroke-width"/>
    <xs:attribute ref="stroke-dasharray"/>
    <xs:attribute ref="stroke-dashoffset"/>
    <xs:attribute ref="stroke-linejoin"/>
    <xs:attribute ref="stroke-linecap"/>
    <xs:attribute ref="stroke-miterlimit"/>
  </xs:complexType>
</xs:element>
```

The veStrokePath element produces an outline of the input path's stroke calculated using the given stroke parameters. The default values for the parameters comes from the corresponding computed property values of the source element. Width attribute percentages are interpreted relative to the source element stroke-width property.

13.4 The veSetback element

```
<xs:element name="veSetback">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="transform"/>
    <xs:attribute ref="setback-offset"/>
  </xs:complexType>
</xs:element>
```

The veSetback element performs a path "setback" operation: it breaks the path into individual segments and shortens every segment by the distance given by the setback-offset from each side. If offset is a list of four lengths it is interpreted as follows:

- offset after the path beginnings (produced by M/m commands),
- offset before the "inner" path nodes (when non-M/m command is followed by another non-M/m command)
- offset after the "inner" path nodes
- offset before the path ends (when non-M/m command is followed by M/m command)

13.5 The veAffine element

```
<xs:element name="veAffine">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="transformPath"/>
  </xs:complexType>
</xs:element>
```

The veAffine element transforms a path using the specified transformation matrix.

13.6 The veReverse element

```
<xs:element name="veReverse">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
  </xs:complexType>
</xs:element>
```

The veReverse element reverses the direction of the path. In effect, it is as if the path segments have been played backward.

13.7 The veJoin element

```
<xs:element name="veJoin">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="in2"/>
    <xs:attribute ref="connect"/>
  </xs:complexType>
</xs:element>
```

The veJoin element joins two paths together. The @connect# attribute can be either "line" or "none". In case of "none", the path segments are merged together. In case of "line" an "M" command that starts the second path is replaced with "L".

13.8 The veUnion element

```
<xs:element name="veUnion">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="in2"/>
  </xs:complexType>
</xs:element>
```

The veUnion element produces an outline of the union of two shapes.

13.9 The veIntersect element

```
<xs:element name="veIntersect">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="in2"/>
  </xs:complexType>
</xs:element>
```

The veIntersect element produces an outline of the intersection of two shapes.

13.10 The veExclude element

```
<xs:element name="veExclude">
  <xs:complexType>
    <xs:attribute ref="result"/>
    <xs:attribute ref="in"/>
    <xs:attribute ref="in2"/>
  </xs:complexType>
</xs:element>
```

The veExclude element produces an outline of the exclusion of the second shape, provided by in2, from the first shape, provided by in.

13.11 The veFill element

```
<xs:element name="veFill">
  <xs:complexType>
    <xs:attribute ref="in"/>
    <xs:attribute ref="fill"/>
    <xs:attribute ref="transform"/>
  </xs:complexType>
</xs:element>
```

The veFill element fills a shape using the paint given by the fill property. Values of "StrokePaint" and "FillPaint" mean the computed value of stroke and fill (including stroke-opacity and fill-opacity) on the source element. The output of the veFill element is the same as its input.

13.12 The veStroke element

```
<xs:element name="veStroke">
  <xs:complexType>
    <xs:attribute ref="in"/>
    <xs:attribute ref="fill"/>
    <xs:attribute ref="transform"/>
  </xs:complexType>
</xs:element>
```

The veStroke element creates a shape that represents the path of the shape's stroke (taking into account the stroke properties on the source element) and then fills the stroke using the paint server given by the fill property. Values of "StrokePaint" and "FillPaint" mean the computed value of stroke and fill (including stroke-opacity and fill-opacity) on the source element. The output of the veStroke element is the same as its input.

13.13 The veMarker element

```
<xs:element name="veMarker">
  <xs:complexType>
    <xs:attribute ref="in"/>
    <xs:attribute ref="marker-start"/>
    <xs:attribute ref="marker-mid"/>
    <xs:attribute ref="marker-end"/>
    <xs:attribute ref="transform"/>
  </xs:complexType>
</xs:element>
```

The veMarker element draws markers along the input path. Its output is the same as its input.

The veMarkerPath element behaves like veMarker but instead of drawing it produces its output by taking the union of the paths of all the markers.

13.14 The vePath element

```
<xs:element name="vePath">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="vePathRef" minOccurs="1" maxOccurs="unbounded"/>
    <xs:sequence>
    <xs:attribute ref="result"/>
  </xs:complexType>
</xs:element>
```

The vePath element does not take input and its result is the path taken from the shape(s) which it references. The path references come from child vePathRef elements. Individual paths are transformed according to the transformPath attribtue on vePathRef and then joined together in the same manner as veJoin.

13.15 The vePathRef element

```
<xs:element name="vePathRef">
  <xs:complexType>
    <xs:attribute ref="connect"/>
    <xs:attribute ref="reverse"/>
    <xs:attribute ref="transform"/>
    <xs:attribute ref="xlink:href" use="required"/>
  </xs:complexType>
</xs:element>
```

The vePathRef element is a child node for the vePath element that references an individual path. It is an error for this element to reference anything but a primitive shape, a path or a text element.

13.16 Examples

A non-scaling line width:

```
<vectorEffect>
  <veFill/>
  <veStroke transform="ref(host)"/>
  <veMarker/>
</vectorEffect>
```

Non-scaling fill/stroke patterns:

```
<vectorEffect>
  <veFill transform="ref(host)"/>
  <veStrokePath in="SourcePath"/>
  <veFill transform="ref(host)" fill="StrokePaint"/>
  <veMarker/>
</vectorEffect>
```

An effect that strokes a path twice, once normally and then again with a thinner red stroke:

```
<vectorEffect>
  <veStroke/>
  <veStroke fill="red" stroke-width="50%"/>
```

```
</vectorEffect>
```

Using vector effects to produce shared borders on paths:

```
<defs>
  <path id="border1" d="..."/>
  <path id="border2" d="..."/>
  <path id="border3" d="..."/>
  <path id="border4" d="..."/>
  <path id="border5" d="..."/>
</defs>
<vectorEffect>
  <vePath>
    <vePathRef xlink:href="#border1"/>
    <vePathRef xlink:href="#border2"/>
    <vePathRef xlink:href="#border3"/>
  </vePath>
  <veFill color="red"/>
  <vePath>
    <vePathRef xlink:href="#border4"/>
    <vePathRef reverse="true" xlink:href="#border2"/>
    <vePathRef xlink:href="#border5"/>
  </vePath>
  <veFill color="blue"/>
</vectorEffect>
```

13.17 The vector-effect property

The vector-effect property specifies the vector effect to use when drawing an object. Vector effects are applied before any of the other compositing operations: filters, masks and clips.

vector-effect

Value:	'default' | 'non-scaling-stroke' | 'inherit' | <uri>
Initial:	'default'
Applies to:	graphical elements
Inherited:	no
Percentages:	N/A
Media:	visual
Animatable:	yes

The value 'default' corresponds to the following vector effect:

```
<vectorEffect>
  <veFill/>
  <veStroke/>
  <veMarker/>
</vectorEffect>
```

It is the default rendering behaviour from SVG 1.1.

The value 'non-scaling-stroke' is a keyword for a predefined vector effect that causes an object's stroke-width to be unaffected by transformations and zooming. That is:

```
<vectorEffect>
  <veFill/>
  <veStrokePath in="SourcePath"/>
  <veFill transform="ref(host)" fill="StrokePaint"/>
  <veMarker/>
</vectorEffect>
```

Should markers scale in this case?

The 'non-scaling-stroke' is designed so that it can be implemented without the entire vector effect engine. For example, SVG Mobile profiles may include a Basic version of the Vector Effect modules that only allows 'default' and 'non-scaling-stroke' without any of the Vector Effect elements.

The URI value references a vectorEffect element that should be used as the vector effect.

14 Progressive Rendering

When progressively downloading a document, a user agent conceptually builds a tree of nodes in various states. The possible states for these nodes are unresolved, resolved and error. After the startElement SAX event on a node, that node becomes part of the document tree in the unresolved state. When the node's dependencies are successfully resolved, then the node enters the resolved state. When the node's dependencies are found to be in error, then the node enters the error state.

Node dependencies include both children content (like the child elements on a g) and resources (like stylesheets or images referenced by an image) referenced from that node or from its children. Children become resolved when the endElement event occurs on an element. Resources become resolved (or found in error) by a user agent specific mechanism.

A user agent implementing progressive rendering must render the current document tree with the following rules:

- The user agent updates the rendering following each startElement and/or endElement SAX event.
- The user agent renders the conceptual document tree nodes in document order up to, and not including the first node in the 'unresolved' state which has externalResourcesRequired set to true. Nodes in the 'resolved' state are always rendered. Nodes in the unresolved state but with externalResourcesRequired set to false are rendered in their current state. If the node has no rendering (e.g, an image pending a resource), then nothing is rendered for that node.
- If a node enters the error state, then the document enters the error state and progressive rendering stops.

Fonts are an exception to the above rules: startElement and endElement events on font element children font-face, hkern, vkern, missing-glyph, glyph) do not cause an update of the document rendering. However, the endElement event on the font element does cause a document rendering as for other node types.

Example

```
<svg>
  <g externalResourcesRequired="true">
     <rect id="rect_1" .... />
      ...
     <rect id="rect_1000" ..../>
     <image xlink:href="myImage.png" externalResourcesRequired="true" ... />
     <rect id="rect_1001" ..../>
  </g>
</svg>
```

In this example, the g element rendering will start when the /g closing tag has been parsed and processed and when all the resources needed by its children have been resolved. This means that the group's rendering will start when the group has been fully parsed and myImage.png has been successfully retrieved.

Forward reference of use element

```
<svg>
  <use xlink:href="#myRect" x="200" fill="green"/>
  <circle cx="450" cy="50" r="50" fill="yellow" />
  <g fill="red">
     <rect id="myRect" width="100" height="100" />
  </g>
</svg>
```

According to the proposal above, the various renderings will be (the rendering state follows the semi-colon):

Forward reference on use with eRR="true"

```
<svg>
  <use xlink:href="#myGroup" x="200" fill="green"
       externalResourcesRequired="true"/>
    <circle cx="450" cy="50" r="50" fill="yellow" />
    <g fill="red">
        <g id="myGroup">
            <rect id="myRect" width="100" height="100" />
            <use xlink:href="#myRect" x="50" fill="purple"/>
        </g>
    </g>
</svg>
```

Forward reference with use to an element under a container with eRR="true"

```
<svg>
  <use xlink:href="#myRect" x="200" fill="green"/>
    <circle cx="250" cy="50" r="50" fill="pink" />
    <g fill="red" externalResourcesRequired="true">
        <circle cx="450" cy="50" r="50" fill="yellow" />
        <rect id="myRect" width="100" height="100" />
    </g>
</svg>
```

Font Resolution Example

```
<svg xmlns="http://www.w3.org/2000/svg" xmlns:xlink="http://www.w3.org/1999/xlink" version='
     baseProfile="tiny" id="svg-root" width="100%" height="100%" viewBox="0 0 480 360">
 <text x="240" y="230" text-anchor="middle" font-size="120"
    font-family="fontC, fontB, fontA">A</text>
 <defs>
   <font id="fontA" horiz-adv-x="224" >
     <font-face
        font-family="fontA"
        units-per-em="1000"
        panose-1="0 0 0 0 0 0 0 0 0 0"
        ascent="917"
        descent="-250"
        alphabetic="0" />
   <missing-glyph horiz-adv-x="800" d="..." />
   <glyph unicode="A" glyph-name="A" ... />
 </font>

 <font id="fontB" horiz-adv-x="224">
   <font-face
       font-family="fontB"
       units-per-em="1000"
       panose-1="0 0 0 0 0 0 0 0 0 0"
       ascent="917"
       descent="-250"
       alphabetic="0" />
   <missing-glyph ... />
   <glyph unicode="A" glyph-name="B" ... />

 </font>

 <font id="fontC" horiz-adv-x="224" >
   <font-face
       font-family="fontC"
       units-per-em="1000"
       panose-1="0 0 0 0 0 0 0 0 0 0"
       ascent="917"
       descent="-250"
       alphabetic="0" />
     <missing-glyph ... />
     <glyph unicode="A" glyph-name="C" ... />
   </font>
 </defs>
</svg>
```

Progressive rendering

15 Extended links

SVG 1.0 and 1.1 use XLink simple links; a link anchor can only link to a single link target. It is often desirable to have a link anchor point to multiple targets. XLink extended links are the clear design choice to add an extended link capability. Extended links contain multiple locators. In SVG 1.2, activating an extended link causes a menu to be displayed; the text of each menu item is taken from the title on each locator.

The extended-link equivalent to the a element is called xa and the locator elements are called loc. Here is a simple example using xlink:title attributes.

```
<xa>
  <loc xlink:href="http://example.com/A.svg"
    xlink:title="Schematic diagram"/>
  <loc xlink:href="http://example.org/B.svg"
    xlink:title="Parts list"/>
  <!-- content of the link goes here -->
  <path d="M50,50L100,20L30,100z"/>
</xa>
```

The content model of xa is one or more loc elements, followed by the same content that an a element can have. For improved internationalization, title children are allowed as children of the loc element as well as xlink:title attributes on the loc element itself. In addition, a switch element may be used to give multilingual titles. Here is the same example, but using title elements.

```
<xa>
  <loc xlink:href="http://example.com/A.svg">
    <title>Schematic diagram</title>
  </loc>
  <loc xlink:href="http://example.org/B.svg">
    <title>Parts list</title>
  </loc>
  <!-- content of the link goes here -->
  <path d="M50,50L100,20L30,100z"/>
</xa>
```

The behavior of an extended link depends on the number of loc children whose display property has a value other than 'none':

0
: No action, link is disabled

1
: The link is traversed to the single location

2 or more
: A menu is constructed for each displayed loc element,using the text from the title element s. The size of the menu is such that the longest string is not clipped. Once one of the menu items is chosen,the menu disappears, and the selected locator is traversed.

Here is an example with multilingual menu items - Japanese, Russian, French, and an English fallback

```
<xa>
  <loc xlink:href="http://example.com/A.svg">
    <switch>
      <title systemLanguage="jp">図面</title>
      <title systemLanguage="ru">Диаграмма</title>
      <title systemLanguage="fr">Diagramme schématise</title>
      <title>Schematic diagram</title>
    </switch>
  </loc>
  <loc xlink:href="http://example.org/B.svg">
    <switch>
      <title systemLanguage="jp">部品一覧</title>
      <title systemLanguage="ru">Список частей</title>
      <title systemLanguage="fr">Liste des pièces</title>
      <title>Parts list</title>
    </switch>
  </loc>
  <!-- content of the link goes here -->
  <path d="M50,50L100,20L30,100z"/>
</xa>
```

In SVG 1.2 we plan to tighten the content models for both 'a' and 'multiA', for example in text the content model should be different to when it is in graphics.

In SVG 1.2 since we have keyboard support we can add hotkey support to links.

16 Non-graphical Enhancements

16.1 Referencing external titles, descriptions and metadata

SVG 1.2 adds the xlink:href attribute to the title, desc and metadata elements, allowing them to reference of external content. In each case the URI must point to data that can be included as content of the referencing element.

16.2 Adding Copyright information to an SVG document

SVG encourages the use of a common metadata format for inclusion of copyright information. Metadata relevant to the data copyright of the entire document should be added to metadata element of the topmost svg element. This allows the author to unambiguously state the licensing terms for the entire document. The scheme may also be used elsewhere in the document, for pieces that have different licensing. For example, an SVG font may have specific licensing details expressed in its own metadata element.

Note that inclusion of this metadata does not provide the author with a method in which to protect or enforce their copyright, it simply bundles the copyright information with the content in a defined manner. Providing methods, technical or non-technical, for data protection is currently beyond the scope of the SVG specification. For more information on protecting XML content see XML Encryption.

The suggested vocabulary for Copyright information is the Creative Commons Metadata Set. This does not exclude the use of other metadata schemes.

Below is an example of providing a copyright license that allows public distribution and reproduction with attribution but disallows commercial use:

```
<svg>
  <metadata>
    <rdf:RDF xmlns:cc="http://web.resource.org/cc/"
             xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
      <cc:work rdf:about="">
        <cc:license>
           <cc:permits rdf:resource="http://web.resource.org/cc/Reproduction"/>
           <cc:permits rdf:resource="http://web.resource.org/cc/Distribution"/>
           <cc:requires rdf:resource="http://web.resource.org/cc/Attribution"/>
           <cc:prohibits rdf:resource="http://web.resource.org/cc/CommercialUse"/>
        </cc:license>
      </cc:work>
    </rdf:RDF>
  </metadata>

  <!-- graphics go here -->

</svg>
```

Below is an example which prohibits reproduction and distribution.

```
<svg>
  <metadata>
    <rdf:RDF xmlns:cc="http://web.resource.org/cc/"
             xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
      <cc:work rdf:about="">
        <cc:license>
           <cc:prohibits rdf:resource="http://web.resource.org/cc/Reproduction"/>
           <cc:prohibits rdf:resource="http://web.resource.org/cc/Distribution"/>
        </cc:license>
      </cc:work>
    </rdf:RDF>
  </metadata>

  <!-- graphics go here -->

</svg>
```

Below is an example which refers to an external license:

```
<svg>
  <metadata>
    <rdf:RDF xmlns:cc="http://web.resource.org/cc/"
             xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
      <cc:work rdf:about="">
        <cc:license rdf:resource="http://www.example.org/copyright"/>
      </cc:work>
    </rdf:RDF>
  </metadata>

  <!-- graphics go here -->

</svg>
```

Like all metadata processing in SVG, there is no requirement for the SVG User Agent to take any action when it finds copyright information. However, it is recommended that in the cases where a User Agent does understand the Copyright information, then it should use that information. For example, it may display the copyright for source code in a message to the user before it displays the source.

16.3 Specifying a snapshot time

SVG 1.2 adds the snapshotTime attribute to svg elements. The attribute only has an effect on the root svg element.

snapShotTime = " <time>"
: Indicates a moment in time which is most relevant for a still-image of the animated svg content. This time can be used as a hint to the SVG User Agent for rendering a still-image of an animated SVG Document, such as a preview. Animatable: no

17 DOM Enhancements

17.1 DOM Level 3 Support

The SVG 1.2 DOM builds upon and is compatible with the Document Object Model (DOM) Level 3 Specification. In particular:

- The SVG 1.2 DOM requires complete support for DOM Level 3 Core.
- The SVG 1.2 DOM requires support for relevant aspects of the DOM Level 3 Events.
- The SVG 1.2 DOM requires complete support for DOM Level 3 XPath.

Other than those areas listed above, the SVG 1.2 DOM follows the same requirements as the SVG 1.1 DOM.

The most significant change this entails is the addition of Text Events (ie. events that encapsulate some form of textual content, such as text entry, or function key being pressed). Early drafts of SVG 1.0 included keyboard events from the draft DOM level 2 specification. Some SVG viewers implemented this, and the functionality is used in content today. However, due to severe problems with the internationalization aspect, DOM Level 2 dropped the keyboard events before it became a Recommendation. In consequence, SVG 1.0 had nothing to refer to and also dropped these keyboard events. The improved DOM Level 3 Text Events addresses the internationalization aspects. In particular, the programmer will not need to worry whether a particular character was entered using the keyboard, or using an Input Method Editor (IME) as is commonly done for Chinese and Japanese, or by some other method such as an on-screen virtual keyboard; nor do all the different national keyboard layouts matter. It no longer matters if the letter "n" was entered by pressing the "n" key, or by pressing shift plus "n" when caps lock was on. The event merely returns the text that was entered. Of course, keypress information is also available for applications that need this and for keys that do not generate text.

The next most significant change is the addition of DOM XPath support. This requirement was added after developer feedback suggested XPath would greatly assist application development. However, the SVG Working Group has yet to evaluate the applicability of full XPath support in SVG Mobile. It may be necessary to propose a subset XPath for use in Mobile environments.

17.2 Subsetting the DOM for mobile devices

During the later stages of the SVG Mobile 1.1 specifications it became obvious that there was a requirement to subset the SVG and XML DOM in order to reduce the burden on implementations. SVG 1.2 adds new features to the SVG DOM, allowing a subset to be taken that includes as much necessary functionality as possible. SVG 1.2 also proposes a subset, suitable for SVG Tiny implementations.

Furthermore, it should be possible to implement the DOM subset on devices that support SVG Tiny 1.1 although, in this case, the scripting would be external to the SVG document (since SVG Tiny 1.1 does not support inline scripting).

The goal is to provide an API that allows access to initial and animated attribute and property values, to reduce the number of interfaces, to reduce run-time memory footprint using necessary features of the core XML DOM, as well as the most useful features from the Full SVG DOM (such as transformation matrix helper functions).

The new SVG 1.2 DOM features and subset are described in Appendix A.

17.3 Media Interfaces

With the addition of audio and video to SVG 1.2, there is a expanded set of interfaces for media elements. Each of the interfaces for the audio, video, image and feImage elements have an attribute for accessing the media object.

There is an oversight in the SVG 1.0 DOM in that the SVGImageElement interface does not allow access to the DOM of the image it refers to (if that image is an SVG document).

To provide this functionality, SVG 1.2 adds a document attribute to the SVGMedia interface, which is the Document interface of the referenced meda, if one is available. It is unlikely that the SVG specification will describe the format for the returned Document except in the case of a referenced SVG image.

Many media streams have embedded metadata. For example, most digital cameras export images in the EXIF format that embeds information on the photograph, such as the presence of a flash, the date the picture was taken and the model of camera used. SVG 1.2 provides an interface to the referenced media metadata, if the user agent is able to access and process it.

While it would have been consistent to provide an XML-like DOM interface to the referenced media's metadata, this is difficult due to the vast range of metadata schemes across the large number of media formats. Instead, SVG 1.2 provides attribute access to the most common metadata, such as the width and height of visual media, and the duration of timed media. For other properties, there is method for string-based lookup.

The SVG Media interfaces are described below:

```
interface SVGMedia {

    readonly dom::Document document;

    // we can have a simple metadata access this way:
    DOMString getMetadata( in DOMString name );
};


interface SVGVisualMedia : SVGMedia {

    // width and height in pixels (or natural width and height for vector fomats)
    readonly unsigned float width;
    readonly unsigned float height;
};

interface SVGImage : SVGVisualMedia {

    // Defined for binary (pixel-based) images only
    unsigned long getPixel( in unsigned long x, in unsigned long y );

};


interface SVGVideo : SVGVisualMedia {

    readonly unsigned float duration;

};


interface SVGAudibleMedia : SVGMedia {

    readonly unsigned float duration;

};

interface SVGAudio : SVGAudibleMedia {

    // empty

};
```

Note that the getPixel() method on SVGImage may return invalid data in the cases where the image has not yet been loaded.

The above interfaces are accessed from each of the image, feImage, video and audio interfaces as shown below:

```
interface SVGImageElement {
    ....
    readonly SVGImage image;
    ....
};

interface SVGFeImageElement {
    ....
    readonly SVGImage image;
    ....
};

interface SVGVideoElement {
    ....
    readonly SVGVideo video;
    ....
};

interface SVGAudiolement {
    ....
    readonly SVGAudio audio;
    ....
};
```

A future draft of this specification may list a set of property strings and expected results, such as the list of EXIF properties.

If a standardized XML API to image metadata becomes available, then the SVG Working Group will consider adding it to the language.

17.4 Conversion of Mouse Coordinates

While it is possible to convert client space coordinates, such as from a pointer event, to user coordinates using the SVG DOM, SVG 1.2 adds a more convenient way to process the conversion.

Below is the new method to be added to the SVGLocatable interface.

```
interface SVGLocatable {
   // ...

   // converts (clientXArg, clientYArg) coordinates into the
   // current element's user space
   SVGPoint convertClientXY(in long clientXArg, in long clientYArg)
}
```

17.5 Window Interface

The majority of scripted SVG documents in existence make use of the browser specific Window interface, which includes methods such as parseXML and alert. SVG 1.2 will most likely specify an SVGWindow interface, taking into account the de-facto standard that already exists.

A method will be added to the SVGDocument interface to enable access to the SVGWindow interface. The following is the current proposed Window interface in IDL.

Interface SVGWindow provides a global object for scripts embedded in a SVG document.

IDL Definition

```
     interface SVGWindow {

       readonly  attribute StyleSheet    defaultStyleSheet
       readonly  attribute SVGDocument   document
       readonly  attribute Event         evt
       readonly  attribute long          innerHeight
       readonly  attribute long          innerWidth
       attribute DOMString     src

       void              getURL ( in DOMString uri, in EventListener callback );
       DocumentFragment  parseXML ( in DOMString source, in Document document );
       void              postURL ( in DOMString uri, in DOMString data, in EventListener ca
       in DOMString mimeType, in DOMString contentEncoding );
       DOMString         printNode ( in Node node );
       void              alert ( in DOMString message );
       boolean           confirm ( in DOMString message );
       DOMString         prompt ( in DOMString message, in DOMString default );
     };

     interface SVGDocument {

       readonly  attribute SVGWindow     window

     };
```

Attributes

readonly StyleSheet defaultStyleSheet
: The user agent style sheet.

readonly SVGDocument document
: The `SVGDocument`.

readonly Event evt
: The event currently being dispatched. Null if there is no currently processed event.

readonly long innerHeight
: Viewport height in pixels.

readonly long innerWidth
: Viewport width in pixels.

DOMString src
: The URI of the current document. On setting, the new document pointed to by the URI is loaded by the user agent.

Methods

getURL

Get data from the given URL using the HTTP GET method. Notify the callback when done.

Parameters

in DOMString url	The URI reference for the data to be loaded.
in EventListener callback	The method to be invoked when the data is available. The argument passed to the function is an ECMAScript Object with 3 properties: success: true if the data is available, false otherwise contentType: the content type of the data, if the information is known by the user agent content: A string representing the data. If the response was compressed, this property contains the decompressed value.

No Return Value

No Exceptions

parseXML

Convert the given source string into DocumentFragment that belongs to the given XML document. This document fragment does not get inserted in the tree; this can be done with DOM methods like appendChild or insertBefore. If the second parameter is null, a new XML document is created and the given string is parsed as a standalone XML document.

Parameters

in DOMString source	A string containing a XML document fragment.
in Document document	The Document context for parsing the XML fragment.

Return Value

DocumentFragment	An XML Fragment converted from the original DOMString.

No Exceptions

postURL

Send data to the given URL using the HTTP POST method. Notify the callback when done. One can also specify MIME type to be reported to server and encoding to be used (valid values are null, "gzip" and "deflate", some browsers cannot post binary data and will ignore encoding).

Parameters

in DOMString url	The URI reference of the application that will receive the data.
in DOMString data	The data to be sent to the server.

in EventListener callback	The method to be invoked when the data is available. The argument passed to the function is an ECMAScript Object with 3 properties: success: true if the data is available, false otherwise contentType: the content type of the data, if the information is known by the user agent content: A string representing the data. If the response was compressed, this property holds the decompressed value.
in DOMString mimeType	MIME type to be reported to the server.
in DOMString contentEncoding	Encoding to be used.

No Return Value

No Exceptions

printNode

Converts a Node into a DOMString. The string is an XML representation of the Node.

Parameters

in Node node	The Node to be converted.

Return Value

DOMString	A serialized version of the original Node.

No Exceptions

alert

Displays a modal synchronous message to the user if possible in the current user environment. Commonly, this message takes the form of a pop-up window with a single dispose button.

Parameters

in DOMString message	The message to be displayed.

No Return Value

No Exceptions

confirm

Displays a modal synchronous message to the user if possible in the current user environment. The user is able to accept or reject the message. Commonly, this message takes the form of a pop-up window with either a Yes/No or OK/Cancel button pair.

Parameters

in DOMString message	The message to be displayed.

Return Value

boolean	A boolean indicating the user's response. True for accept, False for reject.

No Exceptions

prompt

Displays a modal synchronous message to the user if possible in the current user environment. The user is able to enter a response to the message. Commonly, this message takes the form of a pop-up window with a single text entry field.

Parameters

in DOMString message	The message to be displayed.

in DOMString default	The default response to suggest to the user. This can be displayed in the text field and be modified by the user.

Return Value

DOMString	A string representing the response that the user entered.

No Exceptions

17.6 SVGTimer Interface

The common but non-standard methods setInterval, clearInterval, setTimeout and clearTimeout are used extremely frequently in SVG scripts. However, their functionality is rather limited, especially when considering a cross-platform and language independent scripting environment.

SVG 1.2 adds interfaces to enable better control over timed execution: the SVGRunnable and SVGTimer interfaces.

This proposal has yet to be merged with the SVGWindow interface described above. The methods listed on SVGWindow below should be added to the SVGWindow interface described in the previous section.

The IDL definitions of the new interfaces are described below:

```
interface SVGRunnable
{
          // called when the action have to be run
         void run();
}

interface SVGTimer
{
         // initial delay before the first execution is fired
         // 0 means fire as soon as possible
         attribute long delay;

         // period between each execution, if -1, no additional
         // execution will be fire
         attribute long interval;

         // start the timer
         void start()

         // stop the timer
         void stop()

         // add an execution handler to be called
         addHandler(SVGRunnable handler);

         // remove an execution handler
         removeHandler(SVGRunnable handler)
};

interface SVGWindow
{
         // Creates an SVGTimer with delay=timeout, interval=-1 that will be
         // started right after creation.
         SVGTimer createAndStartTimer(in long timeout)

         // Creates an SVGTimer with delay=timeout, interval=-1 that will be
         // started if start is true.
         SVGTimer createTimer(in long timeout, boolean start);
         // Creates an SVGTimer with delay=timeout, interval=timeout that will
         // be started right after creation.
         SVGTimer createAndStartInterval(in long timeout)

         // Creates an SVGTimer with delay=timeout, interval=timeout that will
         // be started if start is true.
         SVGTimer createInterval(in long timeout, boolean start)
};
```

17.7 Better network data interface

Many SVG implementations that are scriptable have included the non-standard getURL and postURL methods. While convenient, these methods do not facilitate all types of data retrieval over the network. For example, it is not possible to cancel a request once it has been made, it is not clear how to disconnect from the request and the methods only are an interface to the HTTP protocol.

SVG 1.2 adds a DOM Interface to better facilitate the retrieval of data over the network.

17.7.1 URLRequest interface

The URLRequest interface enables a client to retrieve data that is addressable by a URL.

```
interface URLRequest : events::EventTarget // emits "URLResponse" event
with target set to the request
{
  const unsigned short INITIAL   = 0; // after it is created
                                      // or after init is called
  const unsigned short PENDING   = 1; // after submit is called
  const unsigned short COMPLETED = 2; // after URLResponse event comes
  const unsigned short ERROR     = 3; // on lower-level protocol error
                                      // (e.g. connection refused)

  readonly attribute unsigned short requestState;

  attribute DOMString requestText; // body of the request, can only
                                   // set in INITIAL state

  void addRequestHeader( in DOMString header, in DOMString value );
                                   // only in INITIAL state

  // body of the response, only in COMPLETED state
  readonly attribute DOMString responseText;

  // 3-digit status code, only in COMPLETED state
  readonly attribute unsigned long status;

  // status text, only in COMPLETED state
  readonly attribute DOMString statusText;

  // response header iterator, only in COMPLETED state
  NameValuePair getResponseHeader( in unsigned long index );

  // response header count, only in COMPLETED state
  readonly attribute unsigned long responseHeaderCount;

  // parsed body of the response, only in COMPLETED state
  dom::Node parseXML( in dom::Document contextDoc );

  // initialize request, not allowed in PENDING state,
  // sets the state to INITIAL
  void init(  in DOMString method, in DOMString url );
  // abort the request, only in PENDING state,
  // sets the state to ERROR
  void abort();

  // submit the request, sets the state to PENDING
  void submit();
};

interface NameValuePair
{
   readonly attribute DOMString name;
   readonly attribute DOMString value;
};
```

A URLRequest object is created using SVGWindow.

```
interface SVGWindow
{
  ...
  URLRequest createURLRequest();
};
```

The functionality of the common postURL() method is equivalent to the following code:

```
// code for today's postURL:
function postURL( url, body, callback )
{
  var req = createURLRequest()
  req.addEventListener( "URLResponse", callback, false )
  req.requestText = body
  req.submit()
}
```

17.7.2 Raw Socket Connections

The Connection interface provides a client with a method to use raw sockets for communication.

```
interface ConnectionEvent : events::Event // "ConnectionData" event
{
   readonly attribute DOMString data;
};

interface Connection : events::EventTarget
{
   readonly attribute boolean connected;

   void setEncoding( DOMString value ); // might be called before connect

   void connect( in DOMString url ) raises(SVGException)
   void send( in DOMString data );
   void close();
};
```

A Connection object is created using SVGWindow.

```
interface SVGWindow
{
   ...
   Connection createConnection();
};
```

17.7.3 Security

Note that these interfaces expose possible security concerns. The security model that these interfaces work under is defined by the user agent. However, there are a well-known set of common security guidelines used by the browser implementations in this area. For example, most do not allow access to hosts other than the host from which the document was retrieved.

The next draft of SVG 1.2 will clearly list the minimum set of security features that an SVG user agent should put in place for these interfaces.

17.8 Monitoring download progress

Many resources, such as raster images, movies and complex SVG content can take a substantial amount of time to download. In some use cases the author would prefer to delay the display of content or the beginning of an animation until the entire contents of a file have been downloaded. In other cases, the author may wish to give the viewer some feedback that a download is in progress (e.g. a loading progress screen).

17.8.1 The Progress event

The ProgressEvent occurs when the user agent makes progress loading a resource (local or external) referenced by an xlink:href attribute.

The user agent must dispatch a ProgressEvent at the beginning of a load operation (i.e., just before starting to access the resource). This event is of type 'preload'. The value of the 'preload' event's progress property is 0.

The user agent must dispatch a ProgressEvent at the end of a load operation (i.e. after load is complete and the user agent is ready to render the corresponding resource). This event is of type 'postload' event. The value of the 'postload' event's progress property is 1.

The user agent may dispatch a loadProgress event between the 'preload' event and the 'postload' events. Such events are of type 'loadprogress'.

All 'loadprogress' events must follow to the following constraints:

- the progress property on an 'loadprogress' event is strictly greater or equal to zero and strictly smaller than or equal to one.
- for two consecutive 'loadprogress' events, if provided, the progress property of an event must be strictly bigger than the value of the progress property on the preceding event.
- for two consecutive 'loadprogress' events, the loaded property of an event must be strictly bigger than the value of the loaded property on the preceding event.

In the case where the size of the downloading resource is known, such as from HTTP headers, then the progress property reflects the proportion of the current download that has been completed.

In the case where the size of the downloading resource is not known, then the progress property will only ever have the value 0 or 1.

The ProgressEvent has three corresponding event attributes on elements: onpreload, onpostload and onloadprogress.

Below is an example of the ProgressEvent:

```
<svg xmlns="http://www.w3.org/2000/svg" version="1.2"
     xmlns:xlink="http://www.w3.org/1999/xlink">

   <script type="text/ecmascript"><![CDATA[
   function showImage(imageHref) {
       var image = document.getElementById('myImage');
       image.setAttributeNS(xlinkNS, "href", imageHref);
   }

   function imageLoadStart(evt) {
       var progressBar = document.getElementById('progressBar');
       progressBar.setAttributeNS(svgNS, "width", 0);
       var loadAnimation = document.getElementById('loadAnimation');
       loadAnimation.beginElement();
   }

   function imageLoadProgress(evt) {
       var progressBar = document.getElementById('progressBar');
       progressBar.setAttributeNS(svgNS, "width", 100*evt.progress);
   }

   function imageLoadComplete(evt) {
       var progressBar = document.getElementById('progressBar');
       progressBar.setAttributeNS(svgNS, "width", 100);
        var loadAnimation = document.getElementById('loadAnimation');
       loadAnimation.endElement();

   }
   ]]></script>

   <image id="myImage" xlink:href="imageA.png" width="300" height="400"
          onpreload="imageLoadStart(evt)"
          onloadprogress="imageLoadProgress(evt)"
          onpostload="imageLoadComplete(evt)"/>

   <rect onclick="showImage('imageB.png')" width="120"
         height="30" y="400"/>

   <animate id="loadAnimation" ... />

   <rect id="progressBar" ... />
</svg>
```

IDL Definition

```
     interface ProgressEvent : events::Event {
          readonly attribute DOMString       typeArg;
          readonly attribute unsigned long   loaded;
          readonly attribute unsigned long   total;
          readonly attribute float   progress;
          void               initProgressEvent(in DOMString typeArg,
                                                in unsigned long loaded,
                                                in unsigned long total);
     };
```

Attributes

readonly DOMString typeArg

Specifies the event type. One of 'preload', 'loadprogress' or 'postload'.

readonly unsigned long total

Specifies the expected total number of bytes expected in a load operation. This value is ignored for a 'preload' and a 'postload' event. For a 'loadprogress' event, it should specify the total number of bytes expected or be -1 which means that it cannot be computed (for example when the size of the downloaded resource is unknown).

readonly unsigned long loaded

Specifies the number of bytes downloaded since the beginning of the download. This value is ignored for a 'preload' or 'postload' event. For a 'loadprogress' event, this value must be positive.

Methods

initProgressEvent

The initProgressEvent method is used to initialize the value of a ProgressEvent created through the DocumentEvent interface. This method may only be called before the ProgressEvent has been dispatched via the dispatchEvent method, though it may be called multiple times during that phase if necessary. If called multiple times, the final invocation takes precedence.

Parameters

in DOMString typeArg	Specifies the event type.
in unsigned long loaded	Specifies the number of bytes that have been retrieved. This is a positive value.
in unsigned long total	Specifies the expected total number of bytes in this load operation.

No Return Value

No Exceptions

17.9 File Upload

It is desirable for Web applications to have the ability to manipulate as wide as possible a range of user input, including files that a user may wish to upload to a remote server or manipulate inside a rich application. This interface provides application writers with the means to trigger a file selection prompt with which the user can select one or more files. Unlike the file upload forms control available to HTML, this API can be used for more than simply inserting a file into the content of a form being submitted but also allows client-side manipulation of the content, for instance to display an image or parse an XML document.

17.9.1 SVGWindow additions

The SVGWindow interface stores global information and factory methods. The file upload functionality adds a single method that initiates a file dialog.

```
interface SVGWindow {
   ...
   FileDialog createFileDialog (  );
   ...
}
```

The createFileDialog method takes no parameter and returns a FileDialog object. The FileDialog object inherits from EventTarget and it is this possible to attach event listeners to it using the addEventListener method. This method does not produce a user dialog, it merely produces the object with which a file dialog can be opened.

17.9.2 Interface FileDialog

The FileDialog interface is created with a call to SVGWindow::createFileDialog. Its purpose is to control the apparition of a file dialog, and to register the event listeners that will handle the selection of files.

```
interface FileDialog : events::EventTarget {
   void open ( );
}
```

The open method takes no parameter and returns nothing. On being called, it prompts the user with a means to select one or more files. It does not need to be a GUI control, but rather whichever input method the user has at his disposal to select files present on the device. On devices that have no file system, it may still open a dialog for data acquisition, eg an interface to a built-in camera. The user agent should make sure that the user cannot forget about the file upload prompt's existence, for instance in the case of a GUI file selection widget by maintaining it on top of the SVG document.

This method operates in an asynchronous manner so that the files that are selected will be communicated to handlers registered on the FileDialog object to listen to the FilesSelected event. An example follows in which when file selection is performed, the handleEvent method of the listener object will be called with a FilesSelectionEvent object.

```
var fd = createFileDialog();
fd.addEventListener("FilesSelected", listener, false);
fd.open();
```

It would be possible to provide a less verbose API, but it would make it less extensible. For instance, a future specification may add file selection filtering, other events (e.g cancel), and so forth.

17.9.3 Interface FilesSelected

This is an event dispatched for FilesSelected events. It adds a single field fileList which points to the SVGFileList containing the list of selected files. If the file dialog is cancelled, or if no files are selected, the FileList will be defined but its length will be zero.

```
interface FilesSelected : events::Event {
    readonly attribute FileList fileList;
}
```

17.9.4 Interface FileList

This interface exposes the list of files that has been selected through the file dialog. When none have been selected, its length is zero. It is possible that some platforms will only allow for one file to be selected at a time, however when possible a user agent should provide the option to select multiple files in one pass.

```
interface FileList {
   readonly attribute unsigned long numberOfItems;
   File getItem    ( in unsigned long index ) raises( DOMException );
   File removeItem ( in unsigned long index ) raises( DOMException );
}
```

The length of the collection can be obtained through the numberOfItems field. Items can be retrieved using getItem, and removed using removeItem. The latter can be used to filter out files that do not match certain criteria (mime type, file extension, etc).

Is there any need to provide for adding to the list?

17.9.5 Interface File

This interface describes a single file in a FileList, and allows you to know its name, mime type, and to access its content in various convenient ways.

Please note that in order to be memory-efficient, implementations are not required to load the content of files into memory as soon as they have been selected, but only when their content is required by the program. Even then using the network interfaces an implementation may stream the content of a file to a socket and never need to hold more than a few of its bytes in memory. Note however that in case the implementation only provides the content of the file on demand, since the state of the file system may have changed since the pointer was obtained the content may no longer be available, or might have been modified.

```
interface File {
   readonly attribute DOMString fileName;
   readonly attribute DOMString mimeType;
   readonly attribute DOMString fileSize;
   DOMString getDataAsString    (  ) raises(SVGException);
   DOMString getDataAsBase64    (  ) raises(SVGException);
   DOMString getDataAsHexBinary (  ) raises(SVGException);
}
```

The fileName field provides the name of the file, exclusive of its path.

The mimeType field provides the MIME type of the file, if it is known to the user agent. Where available, it must be provided so as to allow users to filter the content of FileLists based on this criterion as is possible in XForms.

The fileSize field provides the size of the file in bytes. User agents should provide it when it is available, but users should keep in mind that it may not always be possible for a user agent to know it before the data has been read.

The getDataAsString, getDataAsBase64, and getDataAsHexBinary methods return the content of the file. Since the file may not be a text file, it is possible that getDataAsString might produce unexpected effects in some languages. Note however that languages such as Ecmascript and Java use a simple array of 16-bit bytes to store their string types, and can thus accomodate any binary data. getDataAsBase64 and getDataAsHexBinary are respectively Base64 and hex-binary encoded versions of the content returned by getDataAsString.

If the implementation detects a problem when trying to gain access to the file's content (file is not readable by user, has been removed since the pointer to it was obtained, etc) it must throw an exception. An empty file results in an empty string.

Should we do more to avoid race conditions?

17.9.6 URLRequest additions

In order to avoid costly copying of file content, it is possible to feed files directly into network requests.

```
interface URLRequest {
   ...
  void addContentFromFile ( in File file ); // adds to the body, body illegal
+(discarded) for some methods
   ...
}
```

The addContentFromFile method takes a file and adds it to the body of a request. Note that for some request types (eg GET, HEAD...) it is illegal to have a payload and thus the content will be discarded. If the file cannot be read, an exception will be thrown.

Should it also have addContentFromFileList (in FileList fileList) as a convenience method?

We need to describe how the file being sent might be encoded. For things like PUT requests it needs to be sent as is, but for HTML form emulation we should support at least multipart/form-data.

17.9.7 Connection additions

In order to avoid costly copying of file content, it is possible to stream files directly to a socket.

```
interface Connection {
   ...
   void sendFile ( in File file )  raises(SVGException);
   ...
};
```

The sendFile method takes a file and streams it to the socket. If the file cannot be read, an exception will be thrown.

Should it also have sendFileList (in FileList fileList) as a convenience method?

How does this interact with the encoding set on the Connection?

17.9.8 Security considerations

The file upload feature has security implications. However it does not add any security-related issues above those in the common HTML file upload form widget. Rather, it removes the potential risk of having script access to or setting the default value of the form component which has been a cause for concern in a number of HTML user agents.

17.10 Filtering DOM Events

When an event listener is attached to an element, that listener receives all matching events dispatched by the element. In many cases the listener only requires events that match certain criteria (e.g. a particular attribute name for DOM mutation events or only events in the bubbling phase).

The SVGEventFilter interface is an event listener and event target that filters some events, allowing the script or user agent to only process what is necessary.

```
interface SVGEventFilter : events::EventTarget, events::EventListener
{
  // value for phase and button that prevents filtering
  const unsigned short DONT_FILTER = 0xFFFF;

  attribute unsigned short phase;
  attribute EventTarget target; // null does not filter out anything
  attribute unsigned short button; // for mouse events

  // for mouse motion events, false does not filter out anything
  attribute boolean dragOnly;

  // for mutation events, null does not filter out anything
  attribute DOMString attrLocalName;

  // for mutation events, active only when attrLocalName is non-null
  attribute DOMString attrNamespace;
};
```

SVGEventFilters are created using the SVGWindow interface.

```
interface SVGWindow
{
   ...
   SVGEventFilter createEventFilter();
   ...
};
```

The default state of the created filter does not filter any events. The user must set the properties in order to filter.

SVGEventFilter is an event listener and is also an event target, so that other event listeners can be registered with it. It matches the event it receives against the set of criteria that are expressed as properties and either passes that event object to all of its own event listeners if it finds a match or ignores the event if it does not find a match.

17.11 Persistent Client-side Data storage

Many applications benefit from the ability to store data between sessions on the client machine. SVG 1.2 adds a simple set of methods to store data specific to the SVG Document in the client.

```
interface SVGWindow {
 ...
 void setPersistentValue( in DOMString name, in DOMString value );
 DOMString getPersistentValue( in DOMString name );
 ...
};
```

The allowed names for persistent values follow the same rules as XML identifiers. The allowed values can be any string, including an XML serialization (which can be consumed by the parseXML() method and generated by the printNode() method).

The user agent keeps a table of persistent values separate for each domain. There is no set limit to how much data can be stored per domain, nor how long. The minimum limits are 10 names, 500 characters and 60 days expiration. If any of the limits are exceeded then the values are silently discarded.

18 Document Object Model Subset

Feedback from the SVG Mobile implementors has shown that a full DOM implementation is too expensive given the current resource limitations of mobile platforms. At the same time, there is interest in providing scripting on these platforms, such as executing scripting actions in response to document events (for example, a mouse activation on a graphical element or a mutation event in the content of the document).

The Document Object Model (DOM) Subset provides a subset of the full DOM Core and DOM Events features. It will also likely be a subset of the full SVG DOM even though more efficient access to SVG specific features might have to be added. The goal of the DOM subset is to require as little additional functionality from the SVG user agent as possible compared to what is needed for an SVG Tiny implementation by other features. The DOM subset will likely be used in conjunction with XML Events.

The SVG working is working on the definition of this API which should offer consistent and efficient access to SVG graphics.

19 RelaxNG Schema for SVG 1.2

A modularized RelaxNG schema for SVG 1.2 is available.

This schema should not be considered to be complete or without error.

It is likely that future drafts of SVG 1.2 will provide element definitions using RelaxNG or a schema language independent format. The SVG Working Group plan to make W3C XML Schema and RelaxNG schemas available for the complete SVG 1.2 language.

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22 Change Log

This draft is identical to the previous draft apart from Appendix A: SVG Tiny 1.2 DOM.

23 Features expected in the next draft

This specification is rapidly approaching Last Call. Here is a list of features that **may be** included in the next draft:

- Major modification to Rendering Custom Content. As described above, the RCC feature will most likely be moved to a separate specification (a merger with XBL).
- properties to control text selection (separation from pointer events).
- an event for notification of overflow in the flowRoot element.
- The Window object has a number of errors that will be fixed
- A method to capture the mouse events