SVG for Displaying OpenMath and MathML Formulae

MAINLINE (CNRS / University of Nice)

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MAINLINE

- Multimedia Applications Involving Non Linear Information for Networked Education
  - Distance Learning
  - Interactive edition and collaborative tools
  - Wearable Computer for E-Learning
- Framework for displaying and editing structured documents
  - Applied to mathematical formulae and graphs

- http://mainline.essi.fr

OpenMath and MathML

- OpenMath
  - Assuming everyone here speaks OpenMath...
- MathML
  - W3C Recommendation (http://www.w3.org/Math)
  - XML language
  - Presentation Markup
  - Content Markup

Displaying Mathematics on the Web

- How to display formulae on the Web
  - Images
  - HTML
  - Plugins
  - Applets
  - MathML Presentation markup
- How to display math content on the Web ?
  - MathML Content markup
  - OpenMath

Displaying Mathematics on the Net (2)

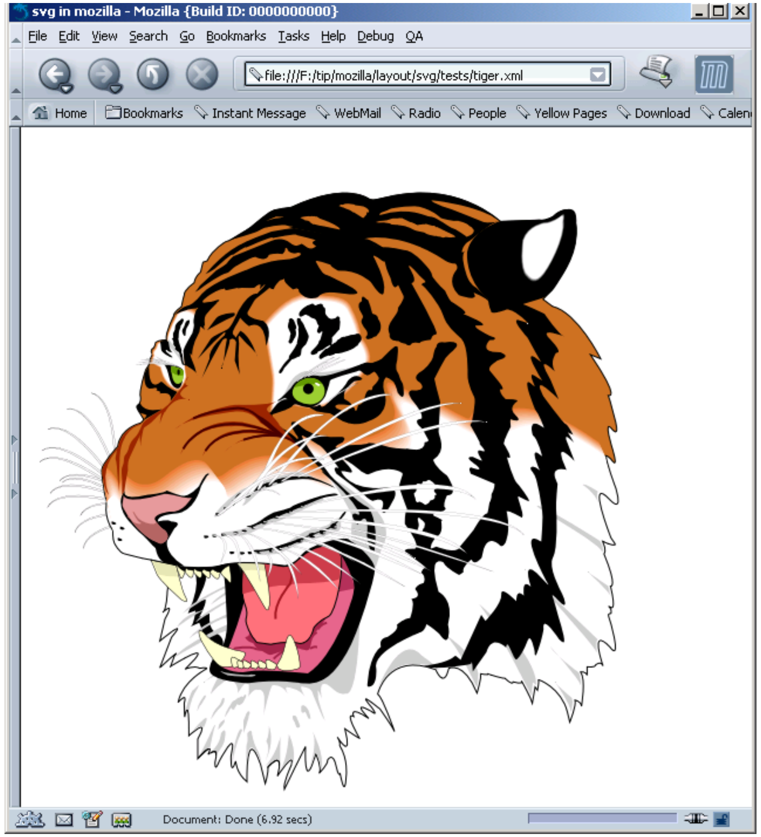
	Images	HTML	Plugins	Applets	MathML
Quality	■	□	■	■	■
Resolution	□	■	■	■	■
Size	□	■	□	□	■
Interactivity	□	□	■	■	▨
Content	□	□	■	■	■
Std. Format	□	□	□	□	■
Fonts	■	□	□	□	□
Diagrams	▨	□	□	□	□
Printing	▨	□	□	□	□

■	Yes
▨	Yes & No
□	No

Quality: rendering quality
Resolution: fixed resolution
Size: document size
Interactivity: allow interaction with formula
Content: allow embedding semantics of formula
Standard format: standard format for the web and for mathematics
Fonts: need system fonts for rendering
Diagrams: allow mixing formulae and diagrams
Printing: printable format (or easy inclusion in printable format)

SVG

- W3C Recommendation
  - “PostScript for Web”
- Description
  - XML language
  - Vectorial
  - Dynamic
  - Interactive
  - Photo filters


svg in mozilla - Mozilla {Build ID: 0000000000}
File Edit View Search Go Bookmarks Tasks Help Debug QA
Home
Bookmarks
Instant Message
WebMail
Radio
People
Yellow Pages
Download
Calen

file:///F:/tip/mozilla/layout/svg/tests/tiger.xml

Document: Done (6.92 secs)

SVG: a Good Format to Display Math

- Avantages
  - Vectorial (zoom, iconification, etc...)
  - Interactive
  - Possible inclusion in drawings
  - Ready to print in PDF format (via FOP)
- Limitations
  - Heavier than MathML (but less than image)

$$\frac{\partial^{n+m}}{\partial x^n \partial y^m}\sin(x.y)$$

$$\nabla^2 f = \mathrm{div}(\mathrm{grad}(f))$$

$$\forall a:(\lceil a\rceil - 1) < a \wedge a \leq \lceil a\rceil$$

$$\int_{c(t)} \omega = \int_{t=b}^{a} \left(\sum a_i(t)\frac{\mathrm{d}x_i}{\mathrm{d}t}\right)\mathrm{d}t$$

SVG and Other Techniques

	Images	HTML	Plugins	Applets	MathML	SVG
Quality	■	□	■	■	■	■
Resolution	□	■	■	■	■	■
Size	□	■	□	□	■	▨
Interactivity	□	□	■	■	▨	▨
Content	□	□	■	■	■	■
Std. Format	□	□	□	□	■	▨
Fonts	■	□	□	□	□	■
Diagrams	▨	□	□	□	□	■
Printing	▨	□	□	□	□	■

■ Yes

▨ Yes & No

□ No

Quality: rendering quality
Resolution: fixed resolution
Size: document size
Interactivity: allow interaction with formula
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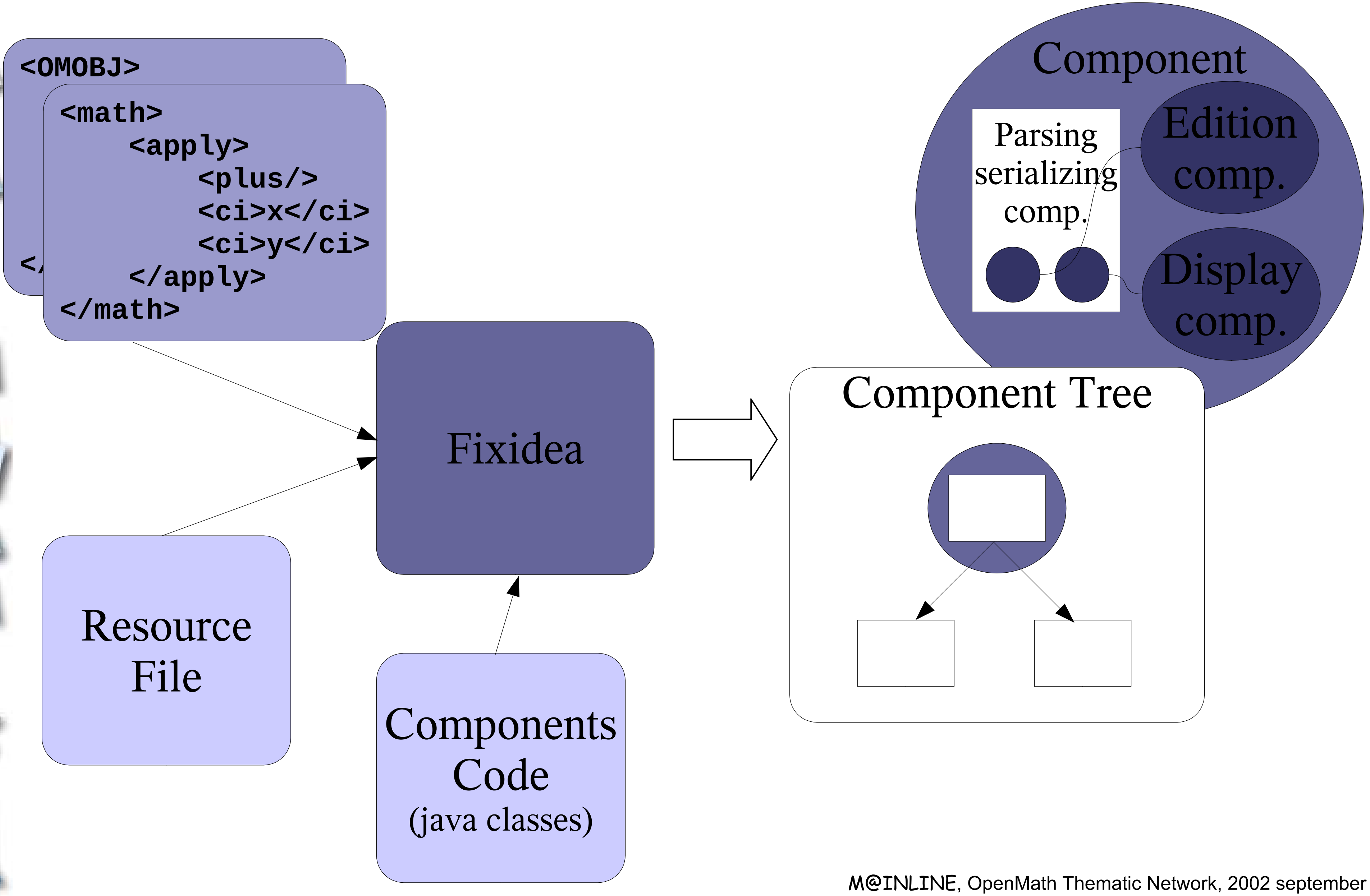
Mathematical Standards to SVG

- MathML Presentation markup to SVG
  - SchemaSoft (http://www.schemasoft.com/MathML)
- MathML Content markup to SVG
  - Content to Presentation with XSLT stylesheet
  - Presentation to SVG with SchemaSoft
  - Limitations
- And why not OpenMath to SVG ?

Fixidea

- Framework for structured document
  - XML documents
  - Rendering
  - Editing
- Proposed solution
  - Components
  - Instantiation of components on XPath expr.
- Applied to XML Mathematical Markup

Fixidea: Global Architecture



```
<OMOBJ>
</
```

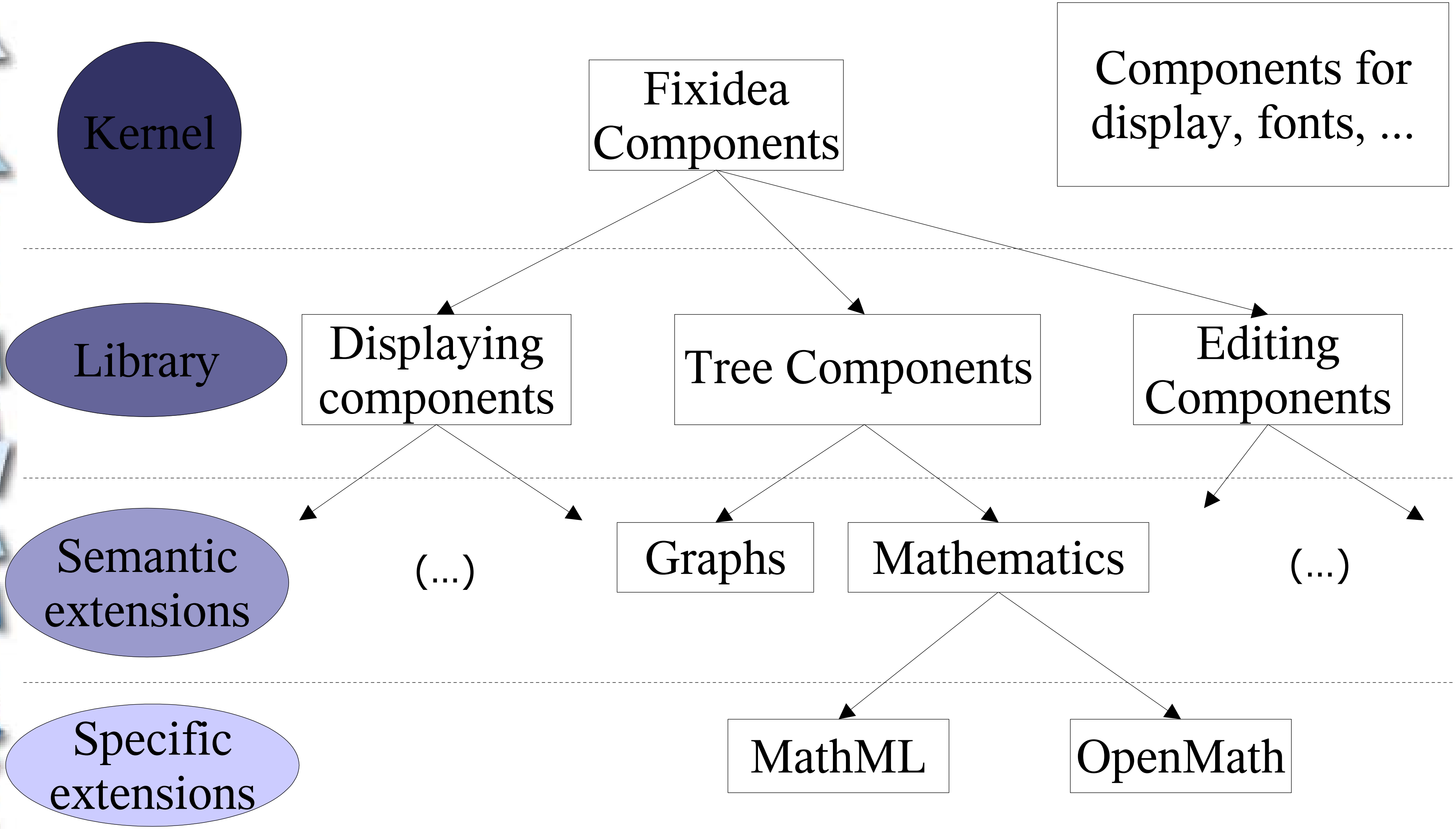
```
<math>
    <apply>
        <plus/>
        <ci>x</ci>
        <ci>y</ci>
    </apply>
</math>
```

Fixidea: Resource File

```
<?xml version="1.0"?>
<OMOBJ>
  <OMA>
    <OMS cd="arith1" name="plus"/>
    <OMV name="x"/>
    <OMV name="y"/>
  </OMA>
</OMOBJ>
```

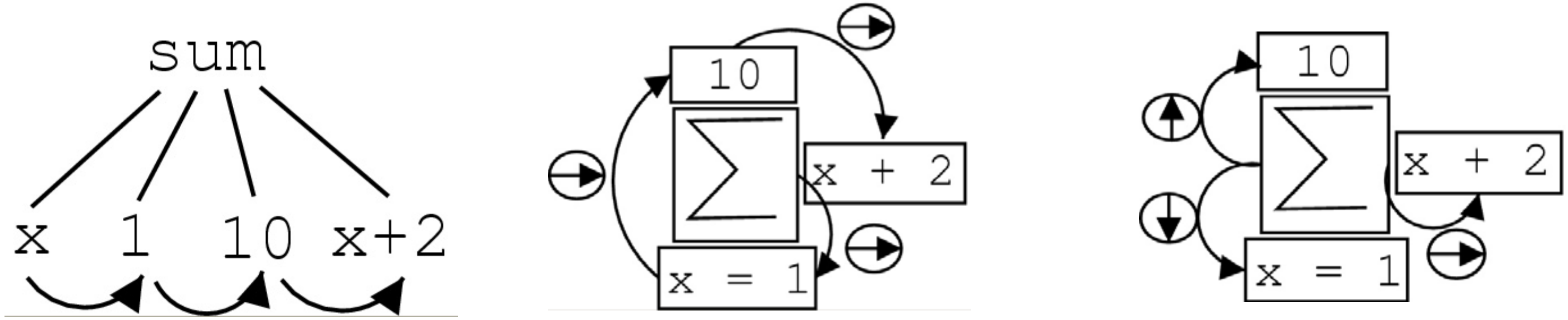
```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE fixidea SYSTEM "resources/fixidea.dtd">
<fixidea>
  <component
      id="OMOBJ"
      match="self::node()[local-name() = 'OMOBJ']"
      type="fr.essi.mainline.fixidea.openmatheditor.OpenMathComponent"
      drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer"
      priority="0"
      mayneedpara="no">
    <parameter name="tag" value="OMOBJ"/>
  </component>
  <component
      id="OMV"
      match="self::OMV"
      type="fr.essi.mainline.fixidea.openmatheditor.OpenMathVariable"
      drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer"
      priority="1000"
      mayneedpara="no">
   <parameter name="tag" value="OMV"/>
   </component>
   <component
      id="OMSplus"
      match="self::OMA/child::*[position() = 1 and
      local-name()='OMS' and @cd='arith1' and @name='plus']"
      type="fr.essi.mainline.fixidea.openmatheditor.OpenMathComponent"
      drawer="fr.essi.mainline.fixidea.drawcomponents.InfixObjectDrawer"
      priority="1000"
      mayneedpara="no">
    <parameter name="tag"      value="OMS"/>
    <parameter name="lspace"   value="mediummathspace"/>
    <parameter name="rspace"   value="mediummathspace"/>
    <parameter name="symbolID" value="plusSymbol"/>
    <parameter name="key"      value="+"/>
  </component>
</fixidea>
```

Fixidea: Classes



Fixidea: Some Technical Points

- Navigation in formulae



- Uses LaTeX fonts
  - TTF to SVG conversion
  - Embedded in SVG documents

Fixidea: Possible extensions

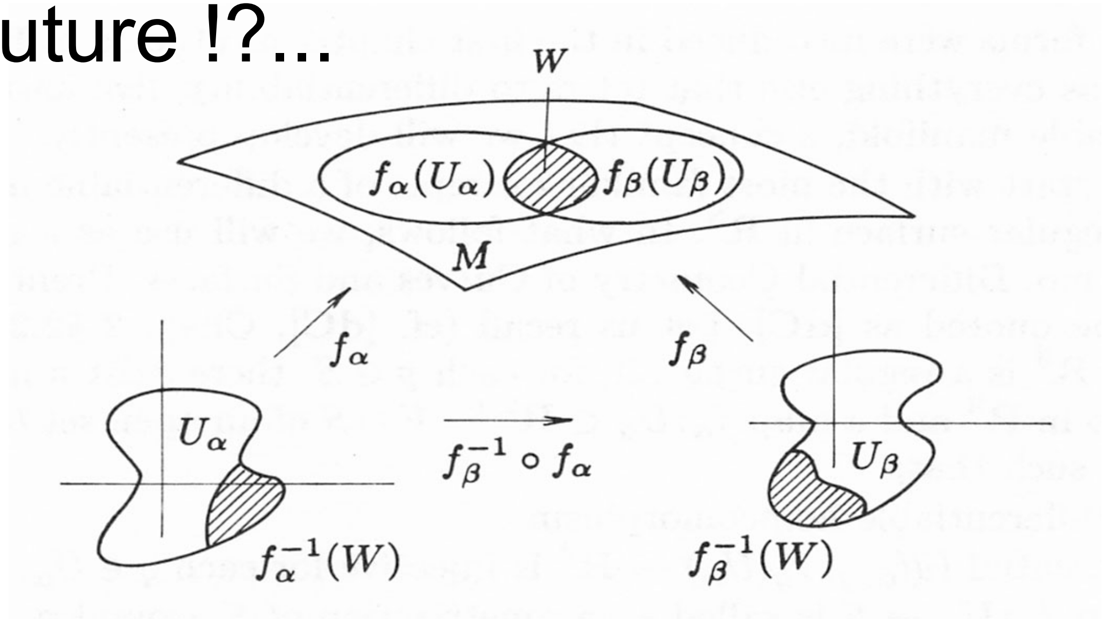
- Currently
  - Produces SVG documents for Web
  - Limited edition and selection
  - Serialization as MathML, SVG
  - Implementation of specific classes for OM
- Future
  - Mix graphs, diagrams and formulae
  - Software component (Java Bean) to include in:
    - Applets
    - Applications

Examples of SVG documents

- Currently:

$$\int_{c(t)} \omega = \int_{t=b}^{a} \left(\sum a_{i}(t)\frac{\mathrm{d}x_{i}}{\mathrm{d}t}\right)\mathrm{d}t = \int_{t=b}^{a} \left(\sum a_{i}(\varphi(\tau))\frac{\mathrm{d}x_{i}}{\mathrm{d}\tau}\frac{\mathrm{d}\tau}{\mathrm{d}t}\right)\mathrm{d}t$$

- In the future !?...



Conclusion

- Support for MathML 2.0
  - Support for Content Markup
  - Doesn't handle Presentation Markup (ci, csymbol)
  - Doesn't handle annotation tags
- Rendering
  - Need to support all rendering types
  - Small graphical problems remain
- First tests with OpenMath

- http://mainline.essi.fr/wiki/bin/view/Fixidea