Plan and Design for a Mathematical Content Editor based on Fixidea (SVG)

MAINLINE (CNRS / University of Nice)

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Plan

- Mainline research project
- Short overview of Fixidea
- SVG: What and Why ?
- Problem with existing techniques
- Our solution: Fixidea (technical details)
- Extension of Fixidea for editing
- Conclusion and perspectives

MAINLINE

- University of Nice / CNRS (*i3S*)
- Multimedia Applications Involving Non Linear Information for Networked Education
  - Knowledge management of learning material
  - Mathematical content services and tools
  - Mobility and E-Learning (wearable computer)
- http://mainline.essi.fr

Fixidea: Overview

- Java Software framework for rendering structured documents
  - XML documents
  - Bridge between content and display
  - Limited edition and selection facilities
- Applied to XML Mathematical Markup
  - MathML Content
  - OpenMath
- Display using SVG

What is SVG ?

- Stands for Scalable Vector Graphics
- Defines vector-based 2D graphics
  - *“Postscript++ for the Web”*
- XML grammar
- W3C Recommendation (*SVG-1.0: 2000/11*)
- Features
  - Plain text format (searchable and selectable)
  - Scalable
  - Zoomable
  - Scriptable (animation) / Interactive (dynamic)

Why SVG for Rendering Formulae ?

- Vectorial rendering
  - Scalable, Zoomable
- Interactive document
- Format conversion
  - Vectorial (.ps)
  - Bitmap (.png, .jpg, .gif, ...)
  - Others xml dialects
- Mixing drawings and math
- Ready to print in PDF format
- Web integrated

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

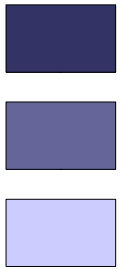
$$\nabla^2 f = \operatorname{div}(\operatorname{grad}(f))$$

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

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

Techniques for Rendering Formulae on the Web

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



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 in Practice

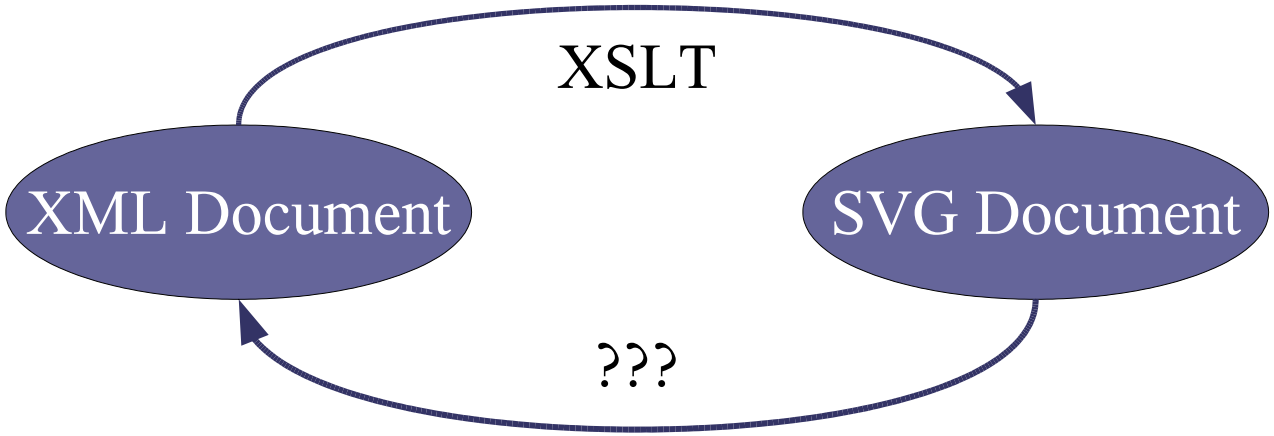
- Available on every kind of platform
  - PC (Linux, Windows), Mac, PDA, etc.
- Java SVG toolkit:
  - Suiggle SVG Browser / Batik (*Apache*)
  - SVG Toolkit (*Csiro*)
  - X-Smiles XML Browser (*X-Smiles org*)
- Can be considered as:
  - A low cost but functionally rich canvas
    - easy to generate and support filter Fx
  - An interactive interface to the underlying document

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
- OpenMath to SVG
  - Nothing
- Conclusion: if it exists, it uses XSLT !

Problem with Existing Solutions

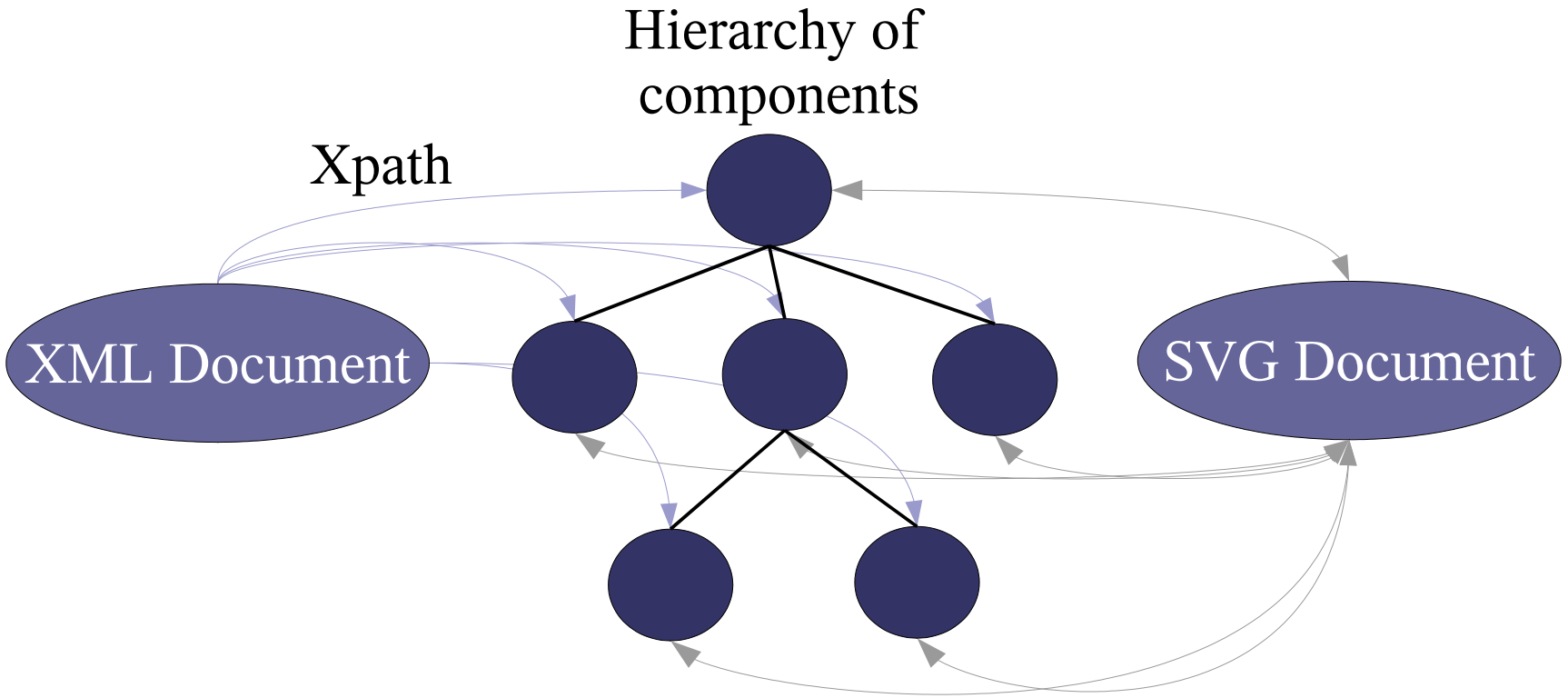
- Existing solutions:
  - *Something* to SVG via XSLT



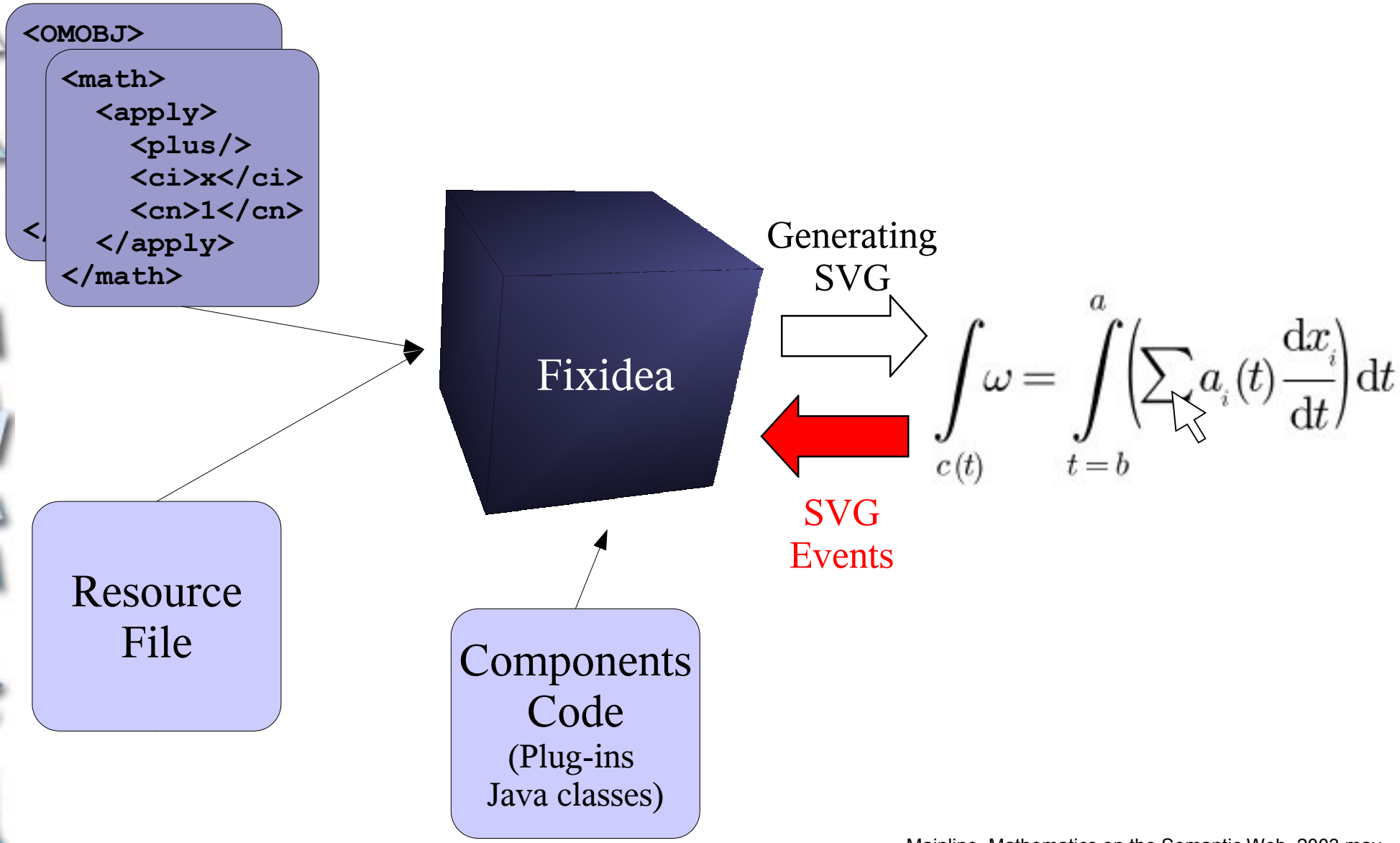
  - For editing, need a backward bridge from SVG to XML

Proposed Solution: Fixidea

- Proposed solution:
  - Components: Java classes (plug-in)
  - Instantiation on XPath expressions



Fixidea: Global Presentation



Fixidea: Resource File

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE fixidea SYSTEM "resources/fixidea.dtd">
<fixidea>
  <component id="math"
             match="self::math"
             type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent"
             drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer"
             priority="&NoPrio;">
    <parameter name="tag" value="math"/>
  </component>
  <component id="plus"
             match="self::apply/*[position()=1 and local-name()='plus'] |
             type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent"
             drawer="fr.essi.mainline.fixidea.drawcomponents.InfixObjectDrawer"
             priority="200">
    <parameter name="tag"       value="plus"/>
    <parameter name="lspace"    value="mediummathspace"/>
    <parameter name="rspace"    value="mediummathspace"/>
    <parameter name="symbolID" value="plusSymbol"/>
    <parameter name="key"       value="+"/>
  </component>
  <component id="ci"
             match="self::ci"
             type="fr.essi.mainline.fixidea.mathmleditor.MathMLComponent"
             drawer="fr.essi.mainline.fixidea.drawcomponents.LineObjectDrawer"
             priority="&MaxPrio;">
    <parameter name="tag"       value="ci"/>
  </component>
</fixidea>
```

```
<?xml version="1.0"?>
<math xmlns="http://...">
  <apply>
    <plus/>
    <ci>x</ci>
    <cn>1</cn>
  </apply>
</math>
```

Fixidea: Important Points (1)

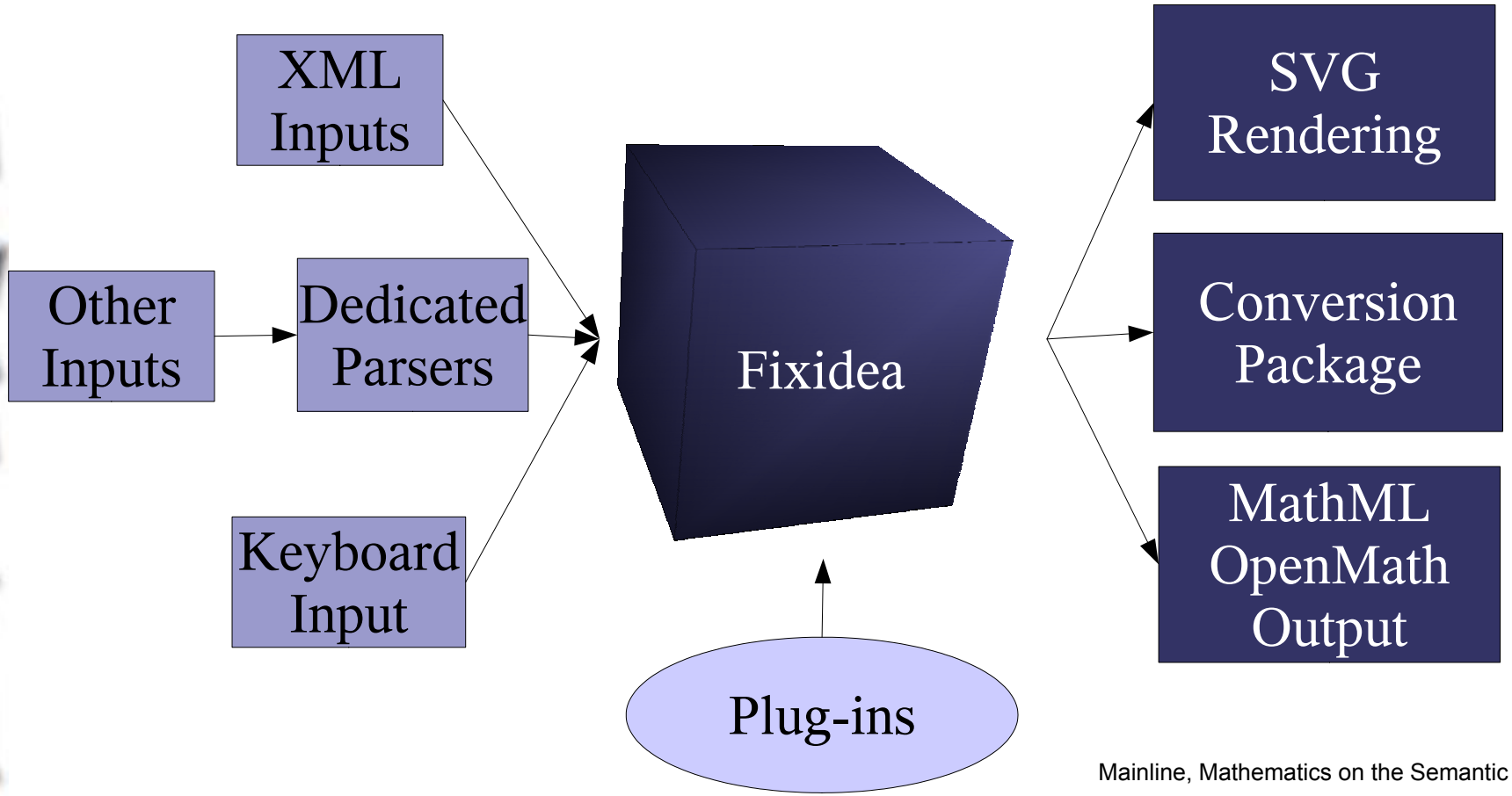
- "Son of JOME" (*Java OpenMath Editor*)
  - Open source
  - Free for all the community
- Designed to be:
  - Generic, Flexible (for math but also for drawings)
  - Extensible (plug-in system)
  - Usable into
    - Browsers
    - Applications

Fixidea: Important Points (2)

- Several input formats
  - MathML Content (*complete*)
  - OpenMath (*some tests*)
  - GraphML (*not yet implemented*)
- Several output formats (*thanks to svg*)
  - Bitmap images (.png, .jpg, .tif, .gif, ...)
  - Vectorial formats (.ps, .svg)
  - Printable formats (.ps, .pdf)

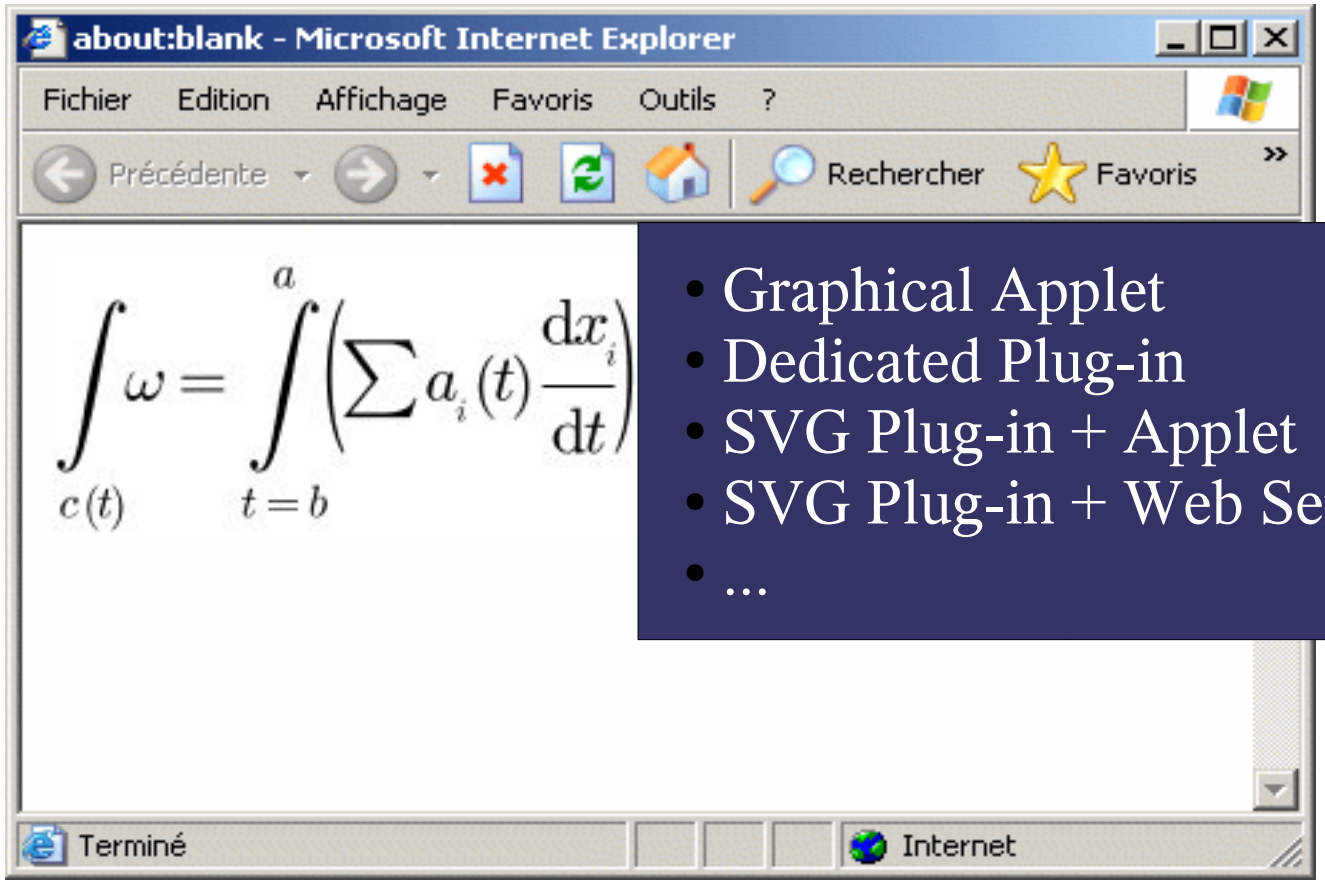
Fixidea: a Core Component for Editing

- Objectives:
  - Embedded as a software component



Fixidea: Editing Math on the Web

- Different solutions (currently exploring)



- Graphical Applet
- Dedicated Plug-in
- SVG Plug-in + Applet
- SVG Plug-in + Web Service
- ...

Fixidea Core System

Fixidea: Possible Extensions

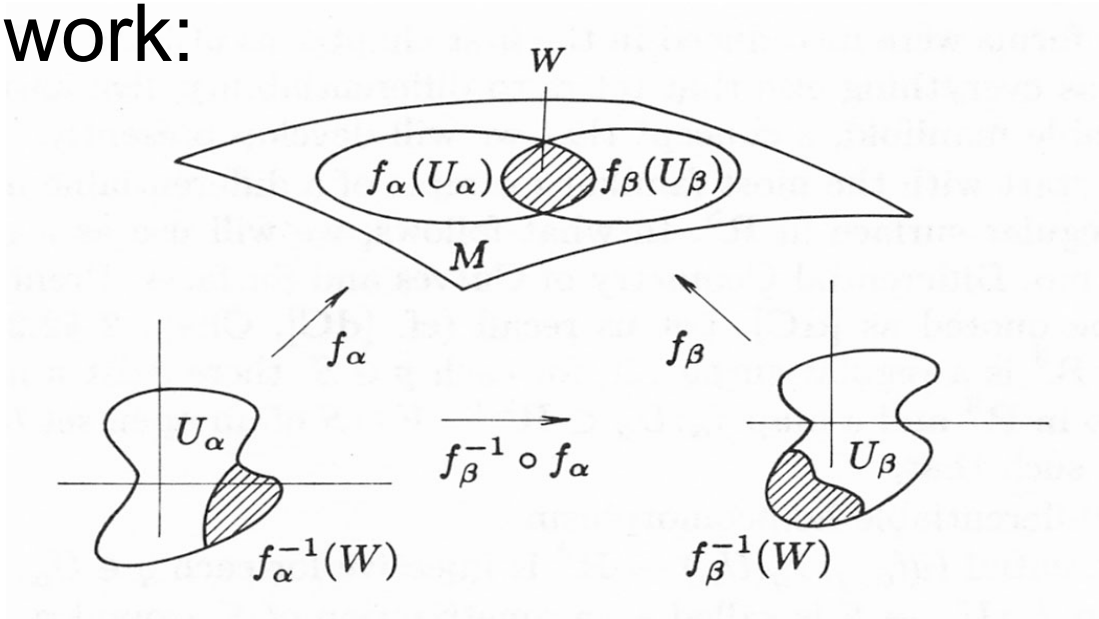
- Currently
  - Produces SVG documents for the Web
  - Limited edition and selection
  - Serialization as MathML, SVG
  - Implementation of specific classes for OM
- Future
  - Mix graphs, diagrams and formulae
  - Software component (Java Bean) to include in:
    - Applets
    - Applications

Examples of SVG documents

- Currently:

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

- Future work:



Conclusion

- MathML 2.0
  - Support for Content Markup (not presentation)
  - Doesn't handle some tags (annotations, declare)
- OpenMath
  - First tests (should be enhanced)
- Rendering
  - Has been enhanced (uses LaTeX fonts)
  - Can use system fonts
- http://mainline.essi.fr/wiki/bin/view/Fixidea

Perspectives

- Adding functionalities for editing formulae
  - Linear edition module
  - 2 dimensional edition module
- Exploring all solutions for editing inside a browser
- Mixing graphs, diagrams and formulae

- Looking for partners to enhance Fixidea:
  - Contributors
  - Within EU instruments