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## **Finalising OpenMath 2.0 (?)**

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## Motivation for OpenMath 2

- Address specific issues and shortcomings which have arisen out of applications development
- Maintain backwards compatibility with OpenMath 1.1 *objects*
- As far as possible maintain backwards compatibility with existing OpenMath software
- As far as possible fit in with existing XML/Web Standardisation work

## Remit from Pisa (September 2002)

- Clean separation of object model and encodings
- Make XML encoding a full XML application
- Replace DTD for XML encoding with Schema
- Support for non-OpenMath XML in annotations in XML encoding
- Compatibility with RDF-style tools (e.g. for CDs)
- Cross referencing between objects
- Types and attributions

# Principle Issues Agreed in Bremen

## ▪ Object Model

- Semantic attributions
- Foreign objects
- Elimination of old restrictions on names
- CDBase
- Canonical URIs for symbols

## ▪ Encodings

- Support full XML syntax
- Structure sharing in both encodings
- Adoption of Relax NG, deprecation of XSD/DTD

## ▪ Content Dictionaries etc.

- Abstract model for CDs and Signatures
- Deprecated CDUSES
- Reference encoding uses namespaces

## Since Bremen ...

- Three New Drafts
  - November
  - April
  - May
- Many editorial changes, re-organisation of text etc.
- Updated bibliography, references to latest versions of standards and specifications
- Set of OpenMath 2 Content Dictionaries Produced
- Made a number of substantive changes ...

# Indexed Variables

- Dropped from draft standard
- No advocates came forward
- Criticisms about equality etc.

# Symbol Roles

- Specification proposed in Bremen was thought too prescriptive
  - e.g. A symbol with role *application* could only appear as first child of an OMA
- New specification more permissive
  - e.g. The only symbols which may appear as the first child of an OMA are those with role *application* or with no role
- Added role *constant*
- The role property now only effects how a symbol can be used to *construct* an OpenMath object
  - e.g. can now express  $\text{OMA}(\text{continuous}, \text{sin})$  where the symbols **continuous** and **sin** both have role *application*
- (Also distinguishes semantic from ordinary attributions)

# Special Values of OMF in XML Encoding

- `<OMF dec="INF">`
- `<OMF dec="-INF">`
- `<OMF dec="NaN">`
  - Interpreted as IEEE infinities and Not A Number
  - Problem that unlike  $\pm INF$ , NaN does not have a unique value and the underlying bit-pattern may be significant
  - Added advice to compliance section to address this
    - Semantically `<OMF dec="NaN">` represents any NaN, whereas `<OMF hex="FFF8000000000001">` is a specific NaN.

# Sharing in XML Encoding

- Dropped use of xlink
  - required extra namespace, extra xlink:type attribute on OMR
- Replaced with href attribute

# Binary Encoding

- Dealt with text encoding issues
  - normally UTF-8 or UTF-16
  - UTF-16 or Latin1 in strings for compatibility
- Added support for streaming objects

## OMOBJ Version Attribute

- Optional version attribute on OMOBJ
  - version is a floating-point number
- Advice in compliance section on handling OpenMath 1.x objects
  - can interpret them as being in openmath namespace or in no-namespace

# OMFOREIGN optional encoding attribute

- Indicate the encoding of the underlying object
- Decided to use a string
  - URIs XML-centric
  - MathML uses string with two pre-defined values: “MathML-Content”, “MathML-Presentation”
- Made recommendations in compliance section
  - For MathML use “MathML-Presentation” or “MathML-Content” (useful for round-tripping)
  - For other XML use namespace
  - For non-XML use MIME type

# Error Objects

- Allow derived objects in error object:

```
<OME>
  <OMS cd="mathml" name="unhandled_csymbol"/>
  <OMFOREIGN encoding="MathML-Content">
    <mathml:csymbol xmlns:mathml="http://www.w3.org/1998/Math/MathML/"
      definitionURL="http://www.nag.co.uk/Airy#A">
      <mathml:mo>Ai</mathml:mo>
    </mathml:csymbol>
  </OMFOREIGN>
</OME>
```

- Also note treatment of invalid XML:

```
<OME>
  <OMS cd="parser" name="invalid_XML"/>
  <OMSTR>
    &lt;OMA&gt; &lt;OMS name="cos" cd="transcl"&gt;
      &lt;OMV name="v"&gt; &lt;/OMA&gt;
    </OMSTR>
  </OME>
```

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## FMPs, DefMPs etc.

- Added optional attribute *kind* to FMP
  - no defined scheme for using this
  - allows future extension
    - for example `<FMP kind="defining"> ... </FMP>`

## Other changes to Standard

- Moved History chapter into primer (under development)
  - agreed by Executive Committee
- Decided that XHTML+MathML version of standard is normative
  - generated from source via bespoke XSL
  - alternatives are:
    - DocBook source (very hard to read, but can be rendered with standard tools)
    - LaTeX source (derived from DocBook via XSL)
    - PDF (generated with pdflatex)

# OpenMath 2 Content Dictionaries

- CD elements in namespace  
<http://www.openmath.org/OpenMathCD>
- OpenMath objects valid OpenMath 2
  - in <http://www.openmath.org/OpenMath> namespace
  - version and cdbase attributes
- Symbols all have a *role*
- No CDUSES
- All CDVersions incremented, CDRevisions set to zero
- Also STS, CD Group files

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## Conclusions

- This standard is a major improvement on OpenMath 1.1, and addresses original remit
- No substantive issues were raised with last draft
- The Working Group Proposes that:
  - This document is now approved by the OpenMath Society as OpenMath 2.0
  - The CDs etc. on [www.openmath.org](http://www.openmath.org) are immediately updated to the new versions
  - The Executive Committee is mandated to approve any minor editorial revisions needed as a result of today's discussions