DITA 1.3 proposed feature #13111

Contents

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Official domain for MathML and a separate domain for semantic equations independent of the data format of the equation content.

Date and version information

Include the following information:

- Proposal Submitted: 1 October 2012
- Change History:
  - 28 May 2013:
    - Added equation domain per TC discussion.
    - Added <mathmlref> element for using MathML elements by reference from external documents per TC discussion.
  - 9 Oct 2012: Changed name of <mathml_container> to <mathml> per TC discussion.
  - 7 Oct 2012:
    - Updated RNC declarations to correct issue with handling of no-namespace elements
    - Updated DTD declarations to correctly configure namespace prefix declarations
    - Corrected `doctypes/rng` to `doctypes/rnc` in the implementation materials.
- Champion: Eliot Kimber,
- Email discussion: *https://lists.oasis-open.org/archives/dita/201205/msg00013.html*

Original requirement

The MathML vocabulary is mature and well-established. It is now a formal part of both HTML5 and EPUB3. It is supported to one degree or another by the latest versions of most Web browsers. It is supported by the main commercial XSL-FO engines. Design Science provides a free, open-source JavaScript MathML library that enables MathML rendering in any Web browser that supports JavaScript.

MathML is used by many existing DITA communities, including learning content, textbooks, and technical documents that involve mathematics.

There are a number of DITA MathML integrations in use, including locally-created integrations and the DITA for Publishers project. While there is no particular difficulty in defining a MathML vocabulary module, there's also no reason for there to be be multiple. Having a TC-provided MathML module would serve the community by removing the need for groups to implement their own or use a less-standard alternative.

Use cases

A MathML integration supports any context in which mathematics of any sort need to be presented, especially where the equations need to be rendered in a variety of contexts and in accessible ways (such as screen readers for digital delivery). Typical use cases include:

- Display and inline equations in learning content
- Formulas used in support of user tasks or concepts in technical documentation
- Math and science textbooks
- Scientific, mathematics, engineering, and mathematics (STEM) scholarly publishing.

In addition to simply containing MathML content, there is a related requirement to be able to semantically identify equations, irrespective of the form the equation content takes, which could be MathML, an image or vector graphic of the rendered equation, TeX markup, or any other way that mathematical equations might be represented. Equations may be rendered inline, as a block, or as a "display equation" that acts as a figure, with a possible title (caption), description, and generated number.

Benefits

Address the following questions:

- Who benefits: DITA users who need to include MathML in their content
- Expected benefit:
  - Easy use of MathML without the need to define a custom MathML vocabulary domain. Out-of-the-box support for MathML delivery by common DITA processing tools.
  - Out-of-the-box markup for identifying equations semantically, independent of the form of the equation content (MathML, image, etc.).
- Potential users: Difficult to quantify, but many learning publications require it (almost all math and science-related publications). Technical documentation for hardware often involves equations. Learning content for math and science subjects require equations.
- Degree of positive impact: Significant, as it makes MathML available to all DITA users without the need to define custom vocabulary modules.

Costs

Costs:

- Maintainers of the DTDs, XSDs, and RNGs: Adds two new vocabulary modules, which must be integrated into the appropriate shell document types.
- Editors of the DITA specification:
  - How many new topics will be required? five new topics for new element types <mathml> and <mathmlref> from the MathML domain and the three element types from the equation domain.
  - How many existing topics will need to be edited? None. Only change to existing topics is generated content model descriptions.
  - Will the feature require substantial changes to the information architecture of the DITA specification? No architectural change.
- Vendors of tools: Tool vendors may decide to support the new domains directly. The nature of this support will depend on the type of processor. Many DITA-aware editors and output processors already support MathML to one degree or another. The equation domain does not require specialized processing, although processors may choose to offer the ability to number display equations separately from figures.
- DITA community-at-large. Will this feature add to the perception that DITA is becoming too complex? Will it be simple for end users to understand?

  This feature adds two new optional vocabulary modules with a total of five new element types. Users who need equations will appreciate having these modules readily available. Users who do not need them may safely ignore them. The general architecture and semantics of DITA are not affected by this proposal.

Technical requirements: MathML Domain

Define a new vocabulary module, mathmlDomain, that defines the following element types:

- <mathml>

  Specializes topic/foreign. Allows as content the <m:math> element from the MathML 3 vocabulary, <mathmlref>, <data>, or <data-about>, as a repeating OR group.
- <mathmlref>

  Specializes topic/xref. Allows for use-by-reference of <m:math> elements from non-DITA XML documents.
- Includes the MathML 3 declarations. See *http://www.w3.org/TR/MathML3/*.

Processors that need to support MathML rendering have a number of options:

- For HTML:
  - Generate inline MathML within the HTML. This is supported in the latest versions of most common browsers at the time of writing.

  - Use the open-source MathJax JavasScript library to render MathML in any browser that supports JavaScript. See *http://www.mathjax.org*.
  - Generate images from the MathML using open-source or commercial tools. See *http://www.w3.org/Math/Software/mathml_software_cat_components.html*.
- For PDF:
  - The commercial XSL-FO engines Antenna House XSL Formatter and RenderX XEP both support rendering of MathML to PDF.
  - Generate EPS, SVG, or images using open-source or commercial tools.

mathmlDomain.ent:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- =============================================================
     DITA MathML Domain

     Defines a specialization of <foreign> that contains
     MathML markup.

     DITA 1.3

     Copyright (c) 2012 OASIS Open

     ============================================================= -->


<!-- ============================================================= -->
<!--                   Formatting DOMAIN ENTITIES                  -->
<!-- ============================================================= -->

<!ENTITY % mathml-d-foreign
   "mathml
   "
>



<!ENTITY   mathml-d-att
  "(topic mathml-d)"
>


<!-- ================== End DITA MathML Domain Entities ============ -->
```

mathmlDomain.mod:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- =============================================================
     DITA MathML Domain

     Defines a specialization of <foreign> that contains
     MathML markup.

     DITA 1.3

     Copyright (c) 2013 OASIS Open

     ============================================================= -->

 <!ENTITY % mathml        "mathml" >
 <!ENTITY % mathmlref     "mathmlref" >
```

```
<!ENTITY % MATHML.prefixed "INCLUDE">
<!ENTITY % MATHML.prefix "m">

<!ENTITY % mathml3.dtd
  SYSTEM "mathml3/dtd/mathml3.dtd"
>%mathml3.dtd;

<!-- ============================================================= -->
<!--                   ELEMENT NAME ENTITIES                       -->
<!-- ============================================================= -->


<!-- ============================================================= -->
<!--                    ELEMENT DECLARATIONS                       -->
<!-- ============================================================= -->

<!ENTITY % mathmlref.content
"
  EMPTY
"
>
<!ENTITY % mathmlref.attributes
             "href
                        CDATA
                                  #IMPLIED
              keyref
                        CDATA
                                  #IMPLIED
              type
                        CDATA
                                  #IMPLIED
              format
                        CDATA
                                  #IMPLIED
              scope
                        (external |
                         local |
                         peer |
                         -dita-use-conref-target)
                                  #IMPLIED
              %univ-atts;
              outputclass
                        CDATA
                                  #IMPLIED"
>
<!ELEMENT mathmlref %mathmlref.content; >
<!ATTLIST mathmlref %mathmlref.attributes; >


<!ENTITY % mathml.content
"
  (%MATHML.pfx;math |
   %mathmlref; |
   %data; |
   %data-about;)*
"
>
<!ENTITY % mathml.attributes
 "
   %id-atts;
  %localization-atts;
  base
    CDATA
    #IMPLIED
  %base-attribute-extensions;
  outputclass
    CDATA
    #IMPLIED

 "
>
<!ELEMENT mathml %mathml.content; >
<!ATTLIST mathml %mathml.attributes; >



<!-- ============================================================= -->
<!--                    SPECIALIZATION ATTRIBUTE DECLARATIONS      -->
<!-- ============================================================= -->

<!ATTLIST mathml           %global-atts;  class CDATA "+ topic/foreign
 mathml-d/mathml ">
<!ATTLIST mathmlref        %global-atts;  class CDATA "+ topic/xref mathml-
d/mathmlref ">


<!-- ================== End MathML Domain ==================== -->
```

Figure 1: DTD-Syntax Vocabulary Module

mathmlDomainMod.xsd:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:m="http://www.w3.org/1998/Math/MathML"
  elementFormDefault="qualified">

  <xs:import schemaLocation="mathml3/mathml3.xsd"
    namespace="http://www.w3.org/1998/Math/MathML"
  />

  <xs:group name="mathml">
    <xs:sequence>
      <xs:choice>
        <xs:element ref="mathml"/>
      </xs:choice>
    </xs:sequence>
  </xs:group>

  <xs:group name="mathml.content">
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element ref="m:math"/>
      <xs:group ref="data.elements.incl" minOccurs="0"/>
    </xs:choice>
  </xs:group>

  <xs:attributeGroup name="mathml.attributes">
    <xs:attribute name="outputclass" type="xs:string"/>
    <xs:attributeGroup ref="global-atts"/>
    <xs:attributeGroup ref="univ-atts"/>
  </xs:attributeGroup>

  <xs:complexType name="mathml.class" mixed="false">
    <xs:sequence>
      <xs:group ref="mathml.content"/>
    </xs:sequence>
    <xs:attributeGroup ref="mathml.attributes"/>
  </xs:complexType>

  <xs:element name="mathml">
    <xs:annotation>
      <xs:documentation>
        The mathml (&lt;<keyword>mathml</keyword>&gt;) element
        contains zero or more MathML equations, along with optional
 &lt;<keyword>data</keyword>&gt;
        or &lt;<keyword>data-about</keyword>&gt; elements, which act as
 metadata for the
        equations.
      </xs:documentation>
    </xs:annotation>
    <xs:complexType mixed="false">
      <xs:complexContent>
        <xs:extension base="mathml.class">
          <xs:attribute ref="class" default="+ topic/foreign mathml-d/mathml
 "/>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

Figure 2: XSD-Syntax Vocabulary Module

mathmlDomainMod.rng:

```
<<!-- =============================================================
     MODULE:    DITA MathML Domain - RNG
     VERSION:   1.3
     DATE:      May 2013
     ============================================================= -->
<!--
     Refer to the latest version of this file by the following URI:
     urn:dita-ng:dita:rng:mathmlDomain.mod.rng
     To refer to this specific version, you may use this value:
     urn:dita-ng:dita:rng:mathmlDomain.mod.rng:1.3
-->
<!-- ============================================================
     SYSTEM:     Darwin Information Typing Architecture (DITA)
     PURPOSE:    Provides elements for including MathML Markup
                 in DITA documents.
     ORIGINAL CREATION DATE:
     May 2013
     (C) Copyright OASIS Open 2013
     All Rights Reserved.
     ============================================================= -->
<grammar
  xmlns="http://relaxng.org/ns/structure/1.0"
  xmlns:a="http://relaxng.org/ns/compatibility/annotations/1.0"
  xmlns:m="http://www.w3.org/1998/Math/MathML"
  datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">

  <define
    name="domains-atts-value"
    combine="choice">
    <value>(topic mathml-d)</value>
  </define>

  <define
```

```
    name="mathml-d-foreign">
    <ref
      name="mathml.element"/>
  </define>

  <define
    name="foreign"
    combine="choice">
    <ref
      name="mathml-d-foreign"/>
  </define>

  <define
    name="mathmlref.content">
    <empty/>
  </define>

  <define
    name="mathmlref.attributes">
    <ref
      name="xref.attributes"/>
  </define>

  <define
    name="mathmlref.element">
    <element
      name="mathmlref">
      <a:documentation>
The MathML reference (&lt;mathmlref>) element is used to refer to a
non-DITA XML document containing MathML markup in order to use the
markup by reference. The reference must be to a MathML &lt;math&gt;
element. The reference may be a URI that addresses an XML document
whose root element is a MathML &lt;math&gt; element or a URI that
addresses and XML document and a fragment identifier that is the XML

ID of a &lt;math&gt; element within the document.
NOTE: To reuse MathML markup stored within a DITA topic, use a normal
content reference from the &lt;mathml&gt; element.

The reference may be direct, via the @href attribute, or indirect,
via the @keyref attribute. For key references, only the key name
should be specified. Any fragment identifier for specifying the ID of
the &lt;mathml&gt; element to use must be specified as part of the key
definition's @href value.

Example: For example, to refer to the &lt;math&gt; element
with the @id value "equation-02" within a larger document using a key
reference, you would define the key like
so:

&lt;keydef keys="mathml-equation-02" href="math/mathml-
equations.xml#equation-02" format="mathml"/>

You would refer to this key using just the key name:

&lt;mathml>
  &lt;mathmlref keyref="mathml-equation-02"/>
&lt;/mathml>

The MathML should be processed and rendered as though the
&lt;m:math&gt; element had occurred directly in the content of the
containing &lt;mathml&gt; element.

This element is part of the DITA MathML domain. Category: Foreign
```

```
elements
      </a:documentation>
      <ref
        name="mathmlref.attlist"/>
      <ref
        name="mathmlref.content"/>
    </element>
  </define>
  <define name="mathmlref.attlist" combine="interleave">
    <ref name="mathmlref.attributes"/>
  </define>

  <define
    name="mathml.content">
    <a:documentation>
The MathML (&lt;mathml>) element contains inline MathML markup or
references to MathML elements stored in a separate non-DITA XML
document.

The purpose of this element is simply to contain MathML markup. It is
not intended, by itself, to convey the semantic of "equation". Rather,
it simply serves to hold one of many possible ways that the content of
an equation may be represented. The companion equation domain provides
elements for representing equations semantically, independent of the
format of the equation content.

The MathML markup must have a root element of "math" within the MathML
namespace "http://www.w3.org/1998/Math/MathML".
This element is part of the DITA MathML domain. Category: Foreign
elements
    </a:documentation>
    <zeroOrMore>
      <choice>
        <externalRef
          href="mathml3.rng"/>
        <ref
          name="mathmlref.element"/>
        <ref
          name="data.element"/>
        <ref
          name="data-about.element"/>
      </choice>
    </zeroOrMore>
  </define>

  <define
    name="mathml.attributes">
    <ref
      name="univ-atts"/>
    <optional>
      <attribute
        name="outputclass"/>
    </optional>
  </define>

  <define
    name="mathml.element">
    <element
      name="mathml">
      <ref
        name="mathml.attlist"/>
      <ref
        name="mathml.content"/>
    </element>
  </define>
  <define name="mathml.attlist" combine="interleave">
    <ref name="mathml.attributes"/>
  </define>

  <define name="mathml.attlist" combine="interleave">
    <ref name="global-atts"/>
    <optional>
      <attribute name="class" a:defaultValue="+ topic/foreign mathml-d/
mathml "/>
    </optional>
  </define>

  <define name="mathmlref.attlist" combine="interleave">
    <ref name="global-atts"/>
    <optional>
      <attribute name="class" a:defaultValue="+ topic/xref mathml-d/
mathmlref "/>
    </optional>
  </define>

</grammar>
```

Figure 3: RNG-Syntax Vocabulary Module

This RNG module is required in order to correctly configure the base MathML declarations for use with no-namespace DITA elements.

```
<grammar
  xmlns="http://relaxng.org/ns/structure/1.0"
  xmlns:a="http://relaxng.org/ns/compatibility/annotations/1.0"
  xmlns:m="http://www.w3.org/1998/Math/MathML"
  datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">
  <include
    href="mathml3/mathml3.rng">
    <define
      name="anyElement">
      <element>
        <anyName>
          <except>
            <nsName
              ns="m"/>
            <nsName
              ns=""/>
          </except>
        </anyName>
        <oneOrMore>
          <attribute>
            <anyName/>
            <text/>
          </attribute>
        </oneOrMore>
        <zeroOrMore>
          <text/>
          <ref
            name="anyElement"/>
        </zeroOrMore>
      </element>
    </define>
  </include>
</grammar>
```

Figure 4: mathml3.rng

Examples: MathML

Provide examples of the proposed feature. Include an example for each of the use cases. Be sure to include edge cases, if known.

MathML inline within a paragraph (no <equation-inline> wrapper):

```
<p>MathML Inline: <mathml>
  <m:math display='inline'>
    <m:semantics>
      <m:mrow>
        <m:msqrt>
          <m:mrow>
            <m:msup>
              <m:mi>a</m:mi>
              <m:mn>2</m:mn>
            </m:msup>
            <m:mo>+</m:mo><m:msup>
              <m:mi>b</m:mi>
              <m:mn>2</m:mn>
            </m:msup>

          </m:mrow>
        </m:msqrt>

      </m:mrow>
    </m:semantics>
  </m:math>
</mathml></p>
```

Inline equation within a paragraph:

```
<p>MathML Inline: <equation-inline>
  <mathml>
    <m:math display='inline'>
      <m:semantics>
        <m:mrow>
          <m:msqrt>
            <m:mrow>
              <m:msup>
                <m:mi>a</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
              <m:mo>+</m:mo><m:msup>
                <m:mi>b</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
            </m:mrow>
          </m:msqrt>
        </m:mrow>
      </m:semantics>
    </m:math>
  </mathml>
</equation-inline></p>
```

Block equation:

```
<p>A block equation:</p>
<equation-block>
  <mathml>
    <m:math>
      <m:semantics>
        <m:mrow>
```

```
          <m:msqrt>
            <m:mrow>
              <m:msup>
                <m:mi>a</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
              <m:mo>+</m:mo><m:msup>
                <m:mi>b</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
            </m:mrow>
          </m:msqrt>
        </m:mrow>
      </m:semantics>
    </m:math>
  </mathml>
</equation-block>
```

Block equation with alternative forms of the equation:

```
<p>A block equation:</p>
<equation-block>
  <mathml>
    <m:math>
      <m:semantics>
        <m:mrow>
          <m:msqrt>
            <m:mrow>
              <m:msup>
                <m:mi>a</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
              <m:mo>+</m:mo><m:msup>
                <m:mi>b</m:mi>
                <m:mn>2</m:mn>
              </m:msup>
            </m:mrow>
          </m:msqrt>
        </m:mrow>
      </m:semantics>
    </m:math>
  </mathml>
  <image keyref="equation-01">
    <alt>square root of a squared plus b squared</alt>
  </image>
</equation-block>
```

Equation within an <equation-display> element with no other content (direct use of <mathml>):

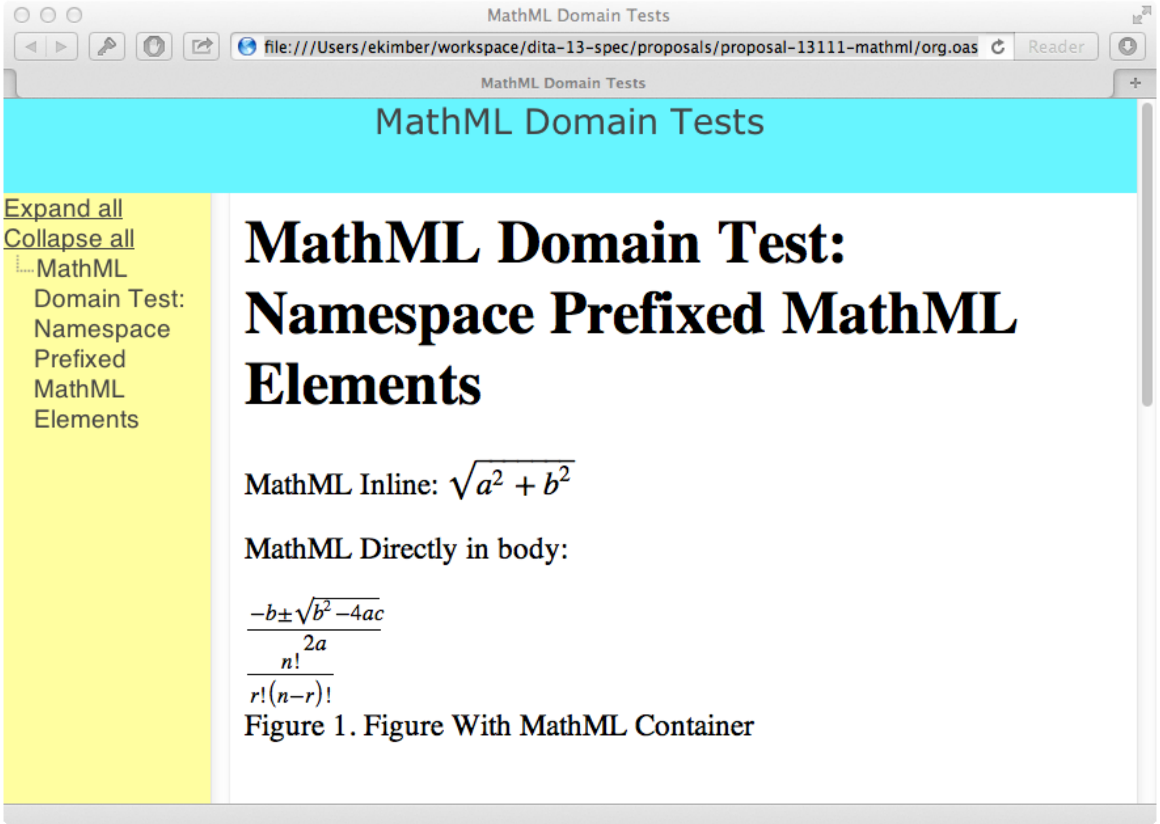
```
<equation-display>
  <title>Display equation With MathML Container</title>
  <mathml>
    <m:math display='block'>
      <m:semantics>
        <m:mrow>
          <m:mfrac>
            <m:mrow>
              <m:mi>n</m:mi><m:mo>!</m:mo>
            </m:mrow>
            <m:mrow>
              <m:mi>r</m:mi><m:mo>!</m:mo><m:mrow><m:mo>(</m:mo>
                <m:mrow>
                  <m:mi>n</m:mi><m:mo>&#x2212;</m:mo><m:mi>r</m:mi>
                </m:mrow>
                <m:mo>)</m:mo></m:mrow><m:mo>!</m:mo>
            </m:mrow>
          </m:mfrac>

        </m:mrow>
      </m:semantics>
    </m:math>
  </mathml>
</equation-display>
```

Equation within an <equation-display> element with other content (use of <equation-block> within <equation-display>):

```
<equation-display>
  <title>Display equation With MathML Container</title>
  <equation-block>
    <mathml>
      <m:math display='block'>
        <m:semantics>
          <m:mrow>
            <m:mfrac>
              <m:mrow>
                <m:mi>n</m:mi><m:mo>!</m:mo>
              </m:mrow>
              <m:mrow>
                <m:mi>r</m:mi><m:mo>!</m:mo><m:mrow><m:mo>(</m:mo>
                  <m:mrow>
                    <m:mi>n</m:mi><m:mo>&#x2212;</m:mo><m:mi>r</m:mi>
                  </m:mrow>
                  <m:mo>)</m:mo></m:mrow><m:mo>!</m:mo>
              </m:mrow>
            </m:mfrac>
          </m:mrow>
        </m:semantics>
      </m:math>
    </mathml>
  </equation-block>
  <p>Where
<equation-inline><mathml><m:math><m:mi>r</m:mi></m:math></mathml></equation-
inline>
is greater than 1.</p>
</equation-display>
```

MathML rendered to HTML using the DITA for Publishers math-to-HTML support. The generated HTML uses the MathJax JavaScript plugin to render the math in the browser.


MathML Domain Tests
file:///Users/ekimber/workspace/dita-13-spec/proposals/proposal-13111-mathml/org.oas
Reader
MathML Domain Tests

MathML Domain Tests

Expand all
Collapse all
MathML Domain Test: Namespace Prefixed MathML Elements

MathML Domain Test: Namespace Prefixed MathML Elements

MathML Inline: $\sqrt{a^2+b^2}$

MathML Directly in body:

$$\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$\frac{n!}{r!(n-r)!}$$

Figure 1. Figure With MathML Container

Figure 5: MathML samples as rendered to HTML with MathJax for rendering

Technical Requirments: Equation Domain

Define a new vocabulary module, equationDomain, that provides elements for representing equations semantically, independent of any particular form of equation content, such as <mathml>, images, text-based equation markup, $\TeX$, and so on. The domain provides three forms of equation: inline, block, and display. Display equations are specializations of <fig> and therefore may have titles, descriptions, and other figure components. Display equations are intended to be numbered. Inline and block equations allow text content and phrase content, which includes the <mathml> element when the MathML domain is integrated. Display equations allow the same content as <fig>.

The equation domain defines the following element types:

- <equation-inline>.

  Represents an equation that is rendered inline with surrounding text, such as within a paragraph. Specializes topic/ph. The content of the equation-inline element may be one or more representations of the equation, such as a <mathml> element, an <image>, text describing or defining the equation, and so on. Direct-child elements of <equation-inline> are taken to be alternative representations of the same semantic equation.

  example: You might use both a <mathml> element and an image element that points to a pre-rendered version of the equation:

  ```
  <equation-inline>
    <mathml><m:math>...</m:math></mathml>
    <image keyref="equation-01-image"/>
  </equation-inline>
  ```

- <equation-block>

  Represents an equation that is rendered as a separate block. Block equations are not normally numbered. Specializes topic/p.

The content of the equation-block element may be one or more representations of the equation, such as a <mathml> element, an <image>, text describing or defining the equation, and so on. Direct-child elements of <equation-block> are taken to be alternative representations of the same semantic equation.

example: You might use both a <mathml> element and an image element that points to a pre-rendered version of the equation:

```
<equation-block>
  <mathml><m:math>...</m:math></mathml>
  <image keyref="equation-02-image"/>
</equation-block>
```

- <equation-display>

  Represents a display equation. Specializes topic/fig. Allows the same content as <fig>, which, when the MathML domain is also integrated, allows both <mathml> and <equation-block> elements, as well as the normal <fig> content elements, such as <title>, <desc>, <image>, and so on. Display equations are expected to be numbered, typically with numbers distinct from the numbers used for other <fig> elements and specializations of <fig>.

  If only a single form of the equation is required, then the content of the <equation-display> may be just that representation, e.g., a <mathml> element or <image>.

  However, if there need to be multiple representations of the same equation or multiple separate equations within the same display, <equation-block> should be used within <equation-display> to contain the equations.

  The display equation may also include non-equation content, such as commentary or prose explanations of the equations as well as <fig-group> to organize subequations within a larger display equation.

  example: A display equation with figure groups:

```
    <equation-display>
      <title>Display Equation with &lt;figgroup></title>
      <figgroup>
        <title>Fig Group 1</title>
        <equation-block><mathml>
          <m:math>
            <m:semantics>
              <m:mrow>
                <m:msqrt>
                  <m:mrow>
                    <m:msup>
                      <m:mi>a</m:mi>
                      <m:mn>2</m:mn>
                    </m:msup>
                    <m:mo>+</m:mo>
                    <m:msup>
                      <m:mi>b</m:mi>
                      <m:mn>2</m:mn>
                    </m:msup>
                  </m:mrow>
                </m:msqrt>
              </m:mrow>
            </m:semantics>
          </m:math>
          </mathml></equation-block>
      </figgroup>
      <figgroup>
        <title>Fig Group 2</title>
        <equation-block><mathml>
          <m:math
            display="block"
            overflow="scroll">
            <m:mtable
```

```
              columnalign="left"
              class="align-star">
             ...
            </m:mtable>
          </m:math>
          </mathml></equation-block>
      </figgroup>
    </equation-display>
```

equationDomain.ent:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- =============================================================
     DITA Equation Domain

     Defines element types that represent equations semantically,
     irrespective of the representation of the equation content.

     DITA 1.3

     Copyright (c) 2013 OASIS Open

     ============================================================= -->


<!-- ============================================================= -->
<!--                   Equation DOMAIN ENTITIES                  -->
<!-- ============================================================= -->

<!ENTITY % equation-d-ph
   "equation-inline
   "
>

<!ENTITY % equation-d-p
   "equation-block
   "
>

<!ENTITY % equation-d-fig
   "equation-display
   "
>



<!ENTITY   equation-d-att
  "(topic equation-d)"
>


<!-- ================== End DITA Equation Domain Entities ============ -->
```

equationDomain.mod:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- =============================================================
     DITA Equation Domain

     Defines element types that represent equations semantically,
     irrespective of the representation of the equation content.

     DITA 1.3
     Copyright (c) 2013 OASIS Open

     ============================================================= -->

 <!ENTITY % equation-inline        "equation-inline" >
 <!ENTITY % equation-block         "equation-block" >
 <!ENTITY % equation-display       "equation-display" >

<!-- ============================================================= -->
<!--                  ELEMENT NAME ENTITIES                        -->
<!-- ============================================================= -->


<!-- ============================================================= -->
<!--                    ELEMENT DECLARATIONS                       -->
<!-- ============================================================= -->

<!ENTITY % equation.cnt
          "(#PCDATA |
           %basic.ph; |
           %data.elements.incl; |
           %foreign.unknown.incl; |
           %image; |
           %txt.incl;)*
          "
>

<!ENTITY % equation-inline.content
"%equation.cnt;
">
<!ENTITY % equation-inline.attributes
              "keyref
                        CDATA
                                  #IMPLIED
              %univ-atts;
              outputclass
                        CDATA
                                  #IMPLIED"
 >
<!ELEMENT equation-inline %equation-inline.content; >
<!ATTLIST equation-inline %equation-inline.attributes; >

<!ENTITY % equation-block.content
"%equation.cnt;
">
<!ENTITY % equation-block.attributes
              "
              %univ-atts;
              outputclass
                        CDATA
                                  #IMPLIED"
 >
<!ELEMENT equation-block %equation-block.content; >
<!ATTLIST equation-block %equation-block.attributes; >

<!ENTITY % equation-display.content
                       "((%title;)?,
                         (%desc;)?,
                         (%figgroup; |
                          %fig.cnt;)* )"
>
<!ENTITY % equation-display.attributes
             "%display-atts;
```

```
              spectitle
                        CDATA
                                  #IMPLIED
              %univ-atts;
              outputclass
                        CDATA
                                  #IMPLIED"
 >
<!ELEMENT equation-display %equation-display.content; >
<!ATTLIST equation-display %equation-display.attributes; >



<!-- ============================================================= -->
<!--                    SPECIALIZATION ATTRIBUTE DECLARATIONS      -->
<!-- ============================================================= -->

<!ATTLIST equation-inline    %global-atts;  class CDATA "+ topic/ph
 equation-d/equation-inline ">
<!ATTLIST equation-block     %global-atts;  class CDATA "+ topic/p
 equation-d/equation-block ">
<!ATTLIST equation-display   %global-atts;  class CDATA "+ topic/fig
 equation-d/equation-display ">


<!-- ================== End MathML Domain ==================== -->
```

Figure 6: Equation Domain DTD-Syntax module

```
<?xml version="1.0" encoding="UTF-8"?>
<grammar
  xmlns="http://relaxng.org/ns/structure/1.0"
  xmlns:a="http://relaxng.org/ns/compatibility/annotations/1.0"
  datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">

  <define
    name="domains-atts-value"
    combine="choice">
    <value>(topic equation-d)</value>
  </define>

  <define
    name="equation-d-ph">
    <ref
      name="equation-inline.element"/>
  </define>

  <define
    name="equation-d-p">
    <ref
      name="equation-block.element"/>
  </define>

  <define
    name="equation-d-fig">
    <ref
      name="equation-display.element"/>
  </define>

  <define
    name="ph"
    combine="choice">
    <ref
```

```
      name="equation-d-ph"/>
  </define>

  <define
    name="p"
    combine="choice">
    <ref
      name="equation-d-p"/>
  </define>

  <define
    name="fig"
    combine="choice">
    <ref
      name="equation-d-fig"/>
  </define>

  <define
    name="equation.cnt">
    <zeroOrMore>
      <choice>
        <ref
          name="ph.cnt"/>
        <ref
          name="text"/>
      </choice>
    </zeroOrMore>
  </define>

  <define
    name="equation-inline.content">
    <zeroOrMore>
      <ref
        name="equation.cnt"/>
    </zeroOrMore>
  </define>
  <define
    name="equation-inline.attributes">
    <ref
      name="univ-atts"/>
    <optional>
      <attribute
        name="outputclass"/>
    </optional>
  </define>
  <define
    name="equation-inline.element">
    <element
      name="equation-inline">
      <a:documentation>
        The Inline Equation element (&lt;equation-inline&gt;) represents an
        equation that is intended to be rendered inline with its surrounding
        content.

        The equation content may be represented in any number of ways,
        including embedded MathML using the &lt;mathml&gt; specialization of
        &lt;foreign&gt;, a reference to an image, inline TeX markup,
        or any other way that an equation might be defined.

        The equation may include alternative forms, such as both a MathML
        version and an image.
      </a:documentation>
      <ref
        name="equation-inline.content"/>
      <ref
        name="equation-inline.attlist"/>
    </element>
  </define>
  <define name="equation-inline.attlist" combine="interleave">
    <ref name="equation-inline.attributes"/>
  </define>


  <define
    name="equation-block.content">
    <zeroOrMore>
      <text/>
      <ref
        name="equation.cnt"/>
    </zeroOrMore>
  </define>
  <define
    name="equation-block.attributes">
    <ref
      name="univ-atts"/>
    <optional>
      <attribute
        name="outputclass"/>
    </optional>
  </define>
  <define
    name="equation-block.element">
    <element
      name="equation-block">
      <a:documentation>
        The Block Equation element (&lt;equation-block&gt;) represents an
        equation that is intended to be rendered as a block element. Block
        equations are not intended to be numbered (see
        &lt;equation-display&gt;).

        The equation content may be represented in any number of ways,
        including embedded MathML using the &lt;mathml&gt; specialization of
        &lt;foreign&gt;, a reference to an image, inline TeX markup,
        or any other way that an equation might be defined.

        The equation may include alternative forms, such as both a MathML
        version and an image.
      </a:documentation>
      <ref
        name="equation-block.content"/>
      <ref
        name="equation-block.attlist"/>
    </element>
  </define>
  <define name="equation-block.attlist" combine="interleave">
    <ref name="equation-block.attributes"/>
  </define>

  <define
    name="equation-display.content">
    <optional>
      <ref
        name="title"/>
    </optional>
    <optional>
      <ref
        name="desc"/>
    </optional>
```

```
   <zeroOrMore>
     <choice>
       <ref
         name="figgroup"/>
       <ref
         name="fig.cnt"/>
     </choice>
   </zeroOrMore>
 </define>
 <define
   name="equation-display.attributes">
   <ref
     name="display-atts"/>
   <optional>
     <attribute
       name="spectitle"/>
   </optional>
   <ref
     name="univ-atts"/>
   <optional>
     <attribute
       name="outputclass"/>
   </optional>
 </define>
 <define
   name="equation-display.element">
   <element
     name="equation-display">
     <a:documentation>
       The Display Equation element (&lt;equation-display&gt;) represents
an
       equation that may have a title or a description and that may be
       numbered. When equations are numbered they are often numbered
separately
       from figures.

       Display equations that are simply a single equation plus,
optionally, a
       title or description, may use the &lt;mathml&gt; element directly.
When
       the display equation content is more complicated, it should use
       &gt;equation-block&gt; to clearly distinguish
       the equation content from non-equation content, such as paragraphs
that
       provide commentary on the equations within the display equation.

       The equation content may be represented in any number of ways,
       including embedded MathML using the &lt;mathml&gt; specialization of
       &lt;foreign&gt;, a reference to an image, inline TeX markup,
       or any other way that an equation might be defined.

       The equation may include alternative forms, such as both a MathML
       version and an image.
     </a:documentation>
     <ref
       name="equation-display.content"/>
     <ref
       name="equation-display.attlist"/>
   </element>
 </define>
 <define name="equation-display.attlist" combine="interleave">
   <ref name="equation-display.attributes"/>
 </define>
```

```
  <define name="equation-inline.attlist" combine="interleave">
    <ref name="global-atts"/>
    <optional>
      <attribute name="class" a:defaultValue="+ topic/ph equation-d/
equation-inline "/>
    </optional>
  </define>

  <define name="equation-block.attlist" combine="interleave">
    <ref name="global-atts"/>
    <optional>
      <attribute name="class" a:defaultValue="+ topic/p equation-d/equation-
block "/>
    </optional>
  </define>

  <define name="equation-display.attlist" combine="interleave">
    <ref name="global-atts"/>
    <optional>
      <attribute name="class" a:defaultValue="+ topic/fig equation-d/
equation-display "/>
    </optional>
  </define>

</grammar>
```

Figure 7: Equation Domain RNG-Syntax module

TBD: Will be generated from RNG once that transform is implemented.

Figure 8: Equation Domain XSD-Syntax module