

A DICOM Prototype in XML with Relationships
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Pathology Informatics 2012

Standards Paucity

- The most cost effective way to design a standard is to reuse an existing one.
 - Change the syntax not the semantics.
- Benefit from the existing design, experience, and documentation.
- In the case of software, design can cost more than coding. Maintenance can cost more than both.
- Evolution not revolution.
 - Extend DICOM and Flow Cytometry Standard with XML schema.

DICOM & RESTful Web Services (for a server)

Tim Dawson & Jim Philbin (HL7, Baltimore, '12)

- Retrieve DICOM
(studies, series, or instances by UID)
- Retrieve all metadata in one XML set
- Retrieve bulk data (including pixels) in one multi-part MIME message

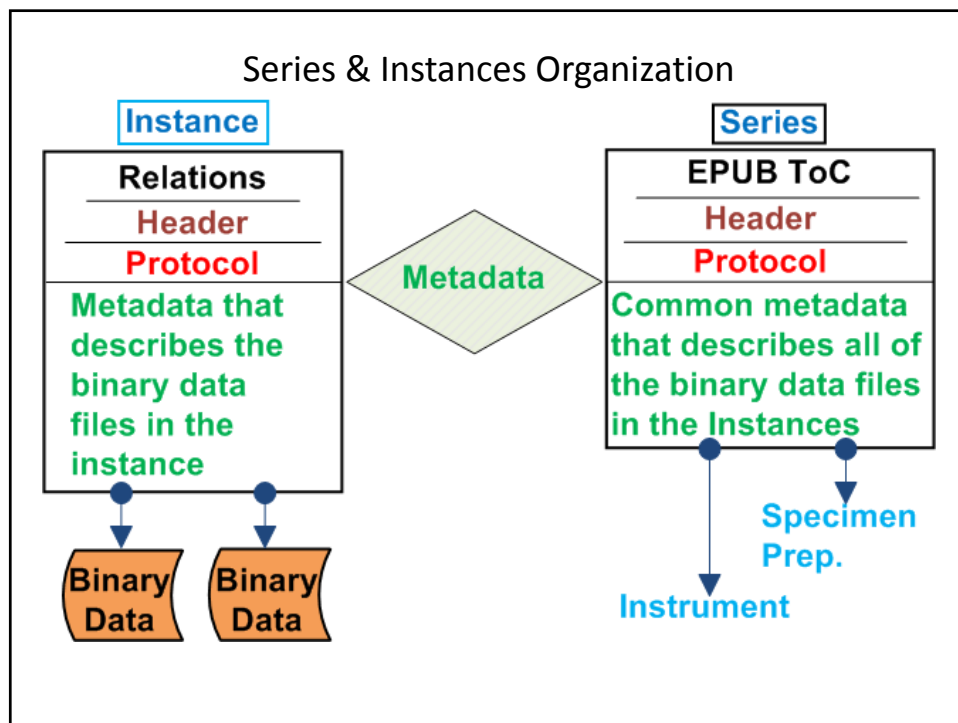
Organization & Hierarchy

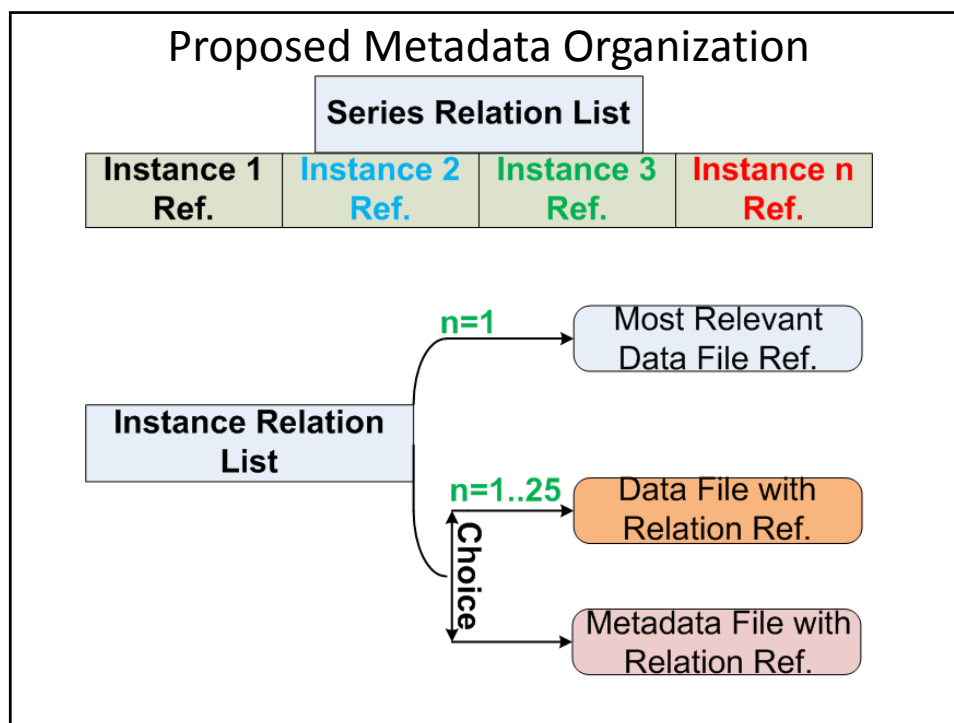
- All of the metadata from the series together with all of the instances' metadata are retrieved together.
 - The metadata of specific objects is retrieved on the client
- Binary or mixed data are subsequently retrieved
 - based on the content of the metadata of specific objects

Pathology-Cytometry Data Separation

- Specimen preparation should be separated into:
 - 1. That which is common to all instances, which is stored with the series description.
 - 2. That which is specific for each instance, which is stored with the instance.

- The instrument description should be separated into:
 - 1. Those items that are unchanged for all of the instances, which are stored with the series description.
 - 2. The settings and configuration that change between instances, which are stored with their specific instance.





DICOM in XML Dilemma

- XML Schema Definition Language (XSDL) is required for description of objects, such as in databases.
- Resource Description Framework (RDF) required for description of relations between objects.
 - Jules Berman was absolutely correct, a standard or similar document should show relationships.
- XSDL and RDF have different schema languages!
- XHTML5 (W3C) cannot be usefully interfaced with XML
 - Polyglot Markup

Solution to XML Dilemma

- Create the equivalent of RDF in XSDL.
- Requirement: optimize readability and flexibility.
- RDF Triple becomes: Subject, Verb, and Object
 - Old Idea
- Creation of data structure required replacement of inflexible attributes with elements.
 - This increased verbosity, but provided the full power of data structures.

XML Relation Image List in XHTML5 Image Data Relation Required an XHTML Schema

Image3 is *Diagnostic*, since it is the *Most_Relevant_Image_Reference* which is the *Data_Of_Greatest_Interest* and is an *Instance* which is *Processed_Data*.

Image3 is descendant of Image2 and Image1.

Image3 is classification-results of gate and linear discriminant metadata.

Fig 1. which is based upon the Image3 file, shows a dividing cell population.

Metadata Relation

The significance of *gate_and_linear_discriminant* metadata is *Informational*.

The role of the *Metadata_Reference* is a *classifier*.

The *gate_and_linear_discriminant* metadata is a classification-description of *Image3*.

This is an imagined algorithm.

The data is hypothetical

Relation XML Code Example

```
<relations_image:Subject>
  <relations:Self>Image3
</relations:Self>
</relations_image:Subject>
<relations_image:Predicate_Phrase/>
  <!--Each Predicate Phrase consists
of a verb and one or more objects-->
<relations_image:Verb_Phrase_Std>
is descendant of
</relations_image:Verb_Phrase_Std>
```

Code Continued

```
<relations_image:Object>
  <links:Curie_Link>
    <links:a href="test:File2.xml">
      Image2</links:a>
    </links:Curie_Link>
  </relations_image:Object>
<relations_image:Object>
  <links:Curie_Link>
    <links:a href="test:File1.xml">
      Image1</links:a>
    </links:Curie_Link>
  </relations_image:Object>
```

Results & Conclusions

- Multiple CytometryML schemas have been created.
 - Need to be revised according to WG 26 and WG 27 supplements.
- Solidify that DICOM VRs and Tags will be represented by attributes.
 - Provides backward compatibility.

Results & Conclusions Continued

- Feasibility of extending DICOM and eventually translating DICOM into the XML Schema Description language (XSDL) established.
- XSDL1.1 has features that will facilitate the creation of a standard and improve its quality.
 - The XSDL1.1 Validation software is immature.
- XSDL can serve as a software design language for DICOM

Sources

- DICOM
 - Existing
 - WG 26 Pathology
 - WG 27 XML and the PACS Restful Services for Input to and output from the PACS
 - XML and binary data

Sources Continued

- ISAC Data Standards Task Force: Archival Cytometry Standard in XML Schema.
 - Compensation
 - Gating
- EPUB Zip Container (Book Standard)
 - XHTML5, XML, Binary
- XHTML5
 - Structured reports & Data Entry Forms
 - Schema Olivier Ishacian
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