CytometryML and Cytomics (L13)

Robert C. Leif*[a] and Stephanie H. Leif[a]
[a]XML_Med, a Division of Newport Instruments,
5648 Toyon Road, San Diego, CA 92115
rleif@rleif.com;
http://www.newportinstruments.com/cytometryml/cytometryml.htm

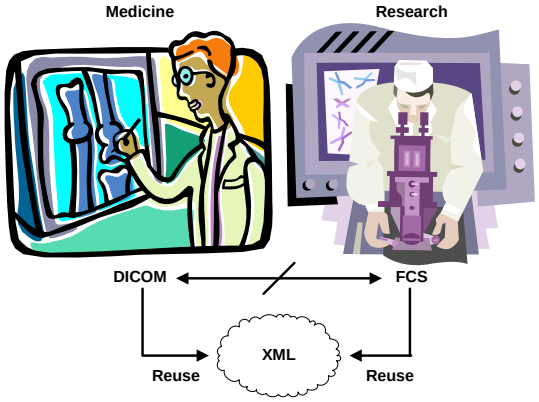
US Government Draft Policy (EU?)

"This strategy of incremental enhancement means moving from secure and appropriate routing of information toward semantic **interoperability** over time to enable **higher levels of health information exchange**. It is anticipated that these higher levels of health information exchange will be required to support meaningful use of HIT and achieve the desired health outcomes. To move toward semantic interoperability, the Federal government will **identify, harmonize and commission the development of standards** (as needed). The Federal government also will also need to ensure that adopted standards and related certification criteria evolve in response to feedback from use, advances in science, and changes in the health care and public health requirements."

Health Information Technology (HIT) Standards Committee Meeting, Top Three Findings Implementation Starter Kit Hearing

1. Create clear interoperability standards
2. Disseminate knowledge of increasing availability of tools and utilities
3. Clarify the requirements of Meaningful Use for each stage of compliance

Bridging two standards



Reuse Existing Standards by Translation into XML

- Digital Imaging and Communications in Medicine (DICOM) standard (http://medical.nema.org/)
  - **Pathology Standard for Digital Microscopy**

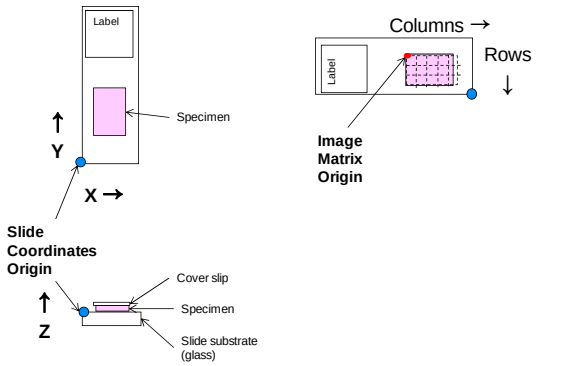
* Supplements:

- 122: Specimen Module and Revised Pathology SOP (Service-Object-Pair) Classes
  - —Specimen, Bar Code, Sampling, Staining
- 145: Whole Slide Microscopic Image IOD (Information Object Definition)and SOP Classes
  - ❖Includes images, Image pyramid storage, Pixel Matrix (x,y,z), focus, Optical Path (incomplete), etc.

Reuse Continued

- Flow Cytometry Standard, FCS 3.1.
  - New names for the data-types were created and data-types from other CytometryML schemas were reused.
  - –ZIP data file format
  - –Instrument Description

DICOM Sup 145, Slide Coordinates Origin and (X,Y,Z) vs. Image Matrix Origin and (Rows, Columns)



Why Extensible Markup Language (XML)?

- Since the DICOM and FCS data representations (syntax) are unique, special interface software must be written to interface each to the other and to other software and to hardware.
- XML is ubiquitous
  - XHTML (Web applications) is XML.
  - A very large amount of data is stored in XML.
  - XML has been interfaced to virtually all commercial software including databases and can be used in forms and documents.

DICOM Organization

1 Patient (Medical Record)

↓

X Studies

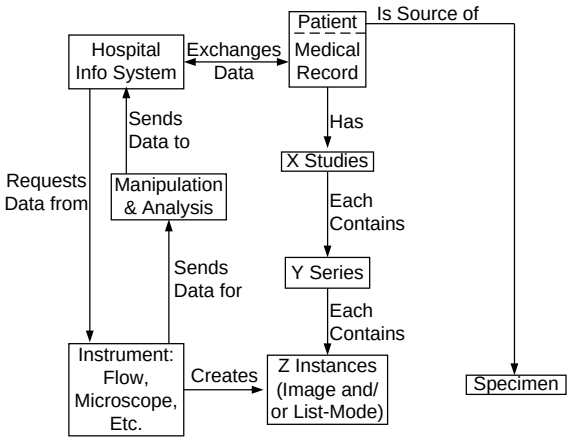
↓

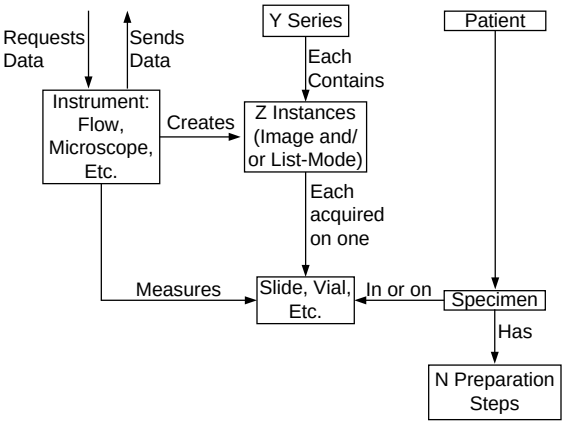
Y Series

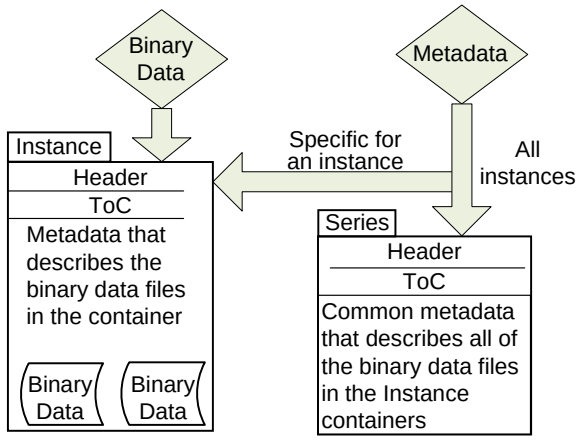
↓

Z Instances

The items below the line are the part of the CytometryML schemas that will be discussed.





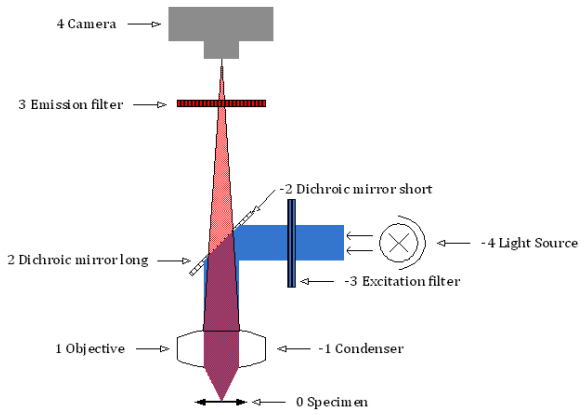


ZIP Data Files

- "Firefox Extension is nothing more than a file hierarchy that has been compressed into a zip file."
  - Firefox XPI
  - Microsoft TechNet: "The new XML formats are based on industry-standard XML and ZIP technologies"
  - An extension is a zipped bundle of files — HTML, CSS, JavaScript, images, and anything else you need — that adds functionality to the Google Chrome browser.

Channel_Info Elements (simplified)

Elements	Example of Values
Analyte Reporter	Anti5Brdu
Parameter	FL1-A
Channel Number	3
Measurement	Fluorescence
Long Name	AlexaFluor
Optical Path	Described below
Statistics	CV= 3.0%
Quality Assurance	Bead-based alignment setup



Optical Path Definition

- Positions of excitation optical elements have negative values;
- Positions of imaging elements have positive values.
- The position of the slide or flow cell that holds the specimen is 0.
- The optics go in a positive direction towards the detector and a negative direction towards the light source.

Conclusions

1. Maximizing reuse including reuse of designs and documentation, besides increasing safety and minimizing development costs, should significantly help to improve international medical informatics infrastructure and facilitate interoperability.
2. It has been possible with XML Schema Definition Language (XSDL) 1.1 to maximize readability, create a modular structure, and strongly typed, reusable data-types.
3. Much of FCS & DICOM has been translated into XSDL and then into XML.
4. The CytometryML schemas can be used with other applications including Microsoft® Office and to generate XML web pages and in the future HTML 5 pages.

Conclusions Cont.

5. This infrastructure improvement should benefit the patients while significantly decreasing health care costs.
6. DICOM can and should and is being extended in XML and should, sometime in the future, evolve into an XML based standard.

Supplementary Information

US Heath Information Technology Standards Committee Summary of Clinical Operations Workgroup Recommendations

Subject Area	Recommended Directional Statement Of Intent For 2013 or 2015
Each entry in this column is a subject area that applies to one or more 2011 measures of meaningful use.	Each entry in this column is a recommended statement of direction, comprising guidance on expected future requirements. This guidance is not intended as a firm implementation requirement for 2013 or 2015.
Summary Records, Clinical Reports, Encounter Messages, Radiology Messages, Allergies and Clinical Notes Content Exchange	HL7 CCD or HL7 CDA templates or HL7 2.5.1 as specified by HITSP

DICOM

1. Introduction and Overview	**2. Conformance**
3. Information Object Definitions	**4. Service Class Specifications**
5. Data Structures and Encoding	**6. Data Dictionary**
7. Message Exchange	8. Network Communication Support for Message Exchange
9. Media Storage and File Format for Data Interchange	10. Media Storage Application Profiles

11. Media Formats and Physical Media for Data Interchange	**12. Media Formats and Physical Media for Data Interchange**
14. Grayscale Standard Display Function	15. Security Profiles
16. Content Mapping Resource	17. Explanatory Information
Web Access to DICOM Persistent Objects (WADO)	