



Integrating
the Healthcare
Enterprise

X-PACS and X-Referral -a standards update-

IHE MHD, HL7 FHIR and
RESTful DICOM

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HL7/IHE roles:

- **Co-chair of the international Application Implementation and Development (AID) HL7 User Group**
- **Co-chair of various Committees, HL7 Netherlands**
- **Contributor to the IHE Laboratory Technical Framework**
- **HL7 Fellow, 2011**

Standards evolve..

- X-PACS, X-Referral
 - IHE XDS, HL7 CDA, DICOM
- New developments
 - HL7 for mobile apps (HL7 FHIR)
 - XDS for mobile apps (IHE MHD)
 - DICOM for mobile apps (RESTful DICOM)

What is REST?

- REpresentational State Transfer
- RESTful services follow certain principles
 - Addressable Resources (URI); Each resource has a unique id
 - <http://myserver.org/patient/123>
 - <http://mypacs.net/study/1/series/5/image/9>
 - Uniform, Constrained Interface (HTTP)
 - GET, PUT, DELETE (crud)
 - Stateless
 - Hypermedia



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HL7 FHIR

**Fast Healthcare
Interoperability Resources**

What is a FHIR 'Resource' ?

- Small, discrete concepts that can be maintained independently
 - Akin to HL7v2 segments, HL7v3 CMETs, DICOM IEs.
- Resources are smallest units of transaction
- Built-in extension mechanism
 - Elements used by 80% of implementers are part of the base resource.
 - All other elements are handled as extensions
- Resources have a 'textual description'

Example - Person

```
<Person xmlns="http://www.hl7.org/fhir">
  <id> mand id Master Resource Id, always first in all resources</id>
  <identifier> Zero+ HumanId A Human identifier for this person</identifier>
  <name> Zero+ HumanName A name associated with the person</name>
  <address> Zero+ Address An address for the person</address>
  <contact> Zero+ Contact A contact detail for the person</contact>
  <dob> opt dateTime The birth date for the person</dob>
  <gender> opt CodeableConcept Administrative Gender</gender>
  <religion> opt CodeableConcept Religion of the person</religion>
  <qualification> <!-- Zero+ Qualifications, Accreditations, Certifications -->
    <id> opt Identifier Identifier for the qualification</id>
    <code> opt CodeableConcept A code for the qualification</code>
    <institution> opt (Organization) Who conferred it</institution>
    <period> opt Interval(date) When the qualification is valid</period>
  </qualification>
  <language> <!-- Zero+ -->
    <code> mand code ISO 639-3 code for language</code>
    <use> opt code How well the language is used</use>
  </language>
  <relatedPerson> <!-- Zero+ Kin, Guardians, Agents, Caregivers -->
    <id> opt HumanId Identifier for the person</id>
    <role> mand CodeableConcept Type of relationship</role>
    <name> opt HumanName Name of the person</name>
    <contact> Zero+ Contact Contact details for the person</contact>
  </relatedPerson>
  <extensions> opt See Extensions </extensions>
  <text> mand Narrative Text summary of person, for human interpretation</text>
</Person>
```

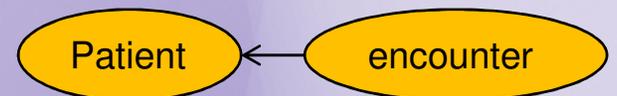
TEXT

FHIR Examples

GET <http://myfhirserver.com/patient/123>



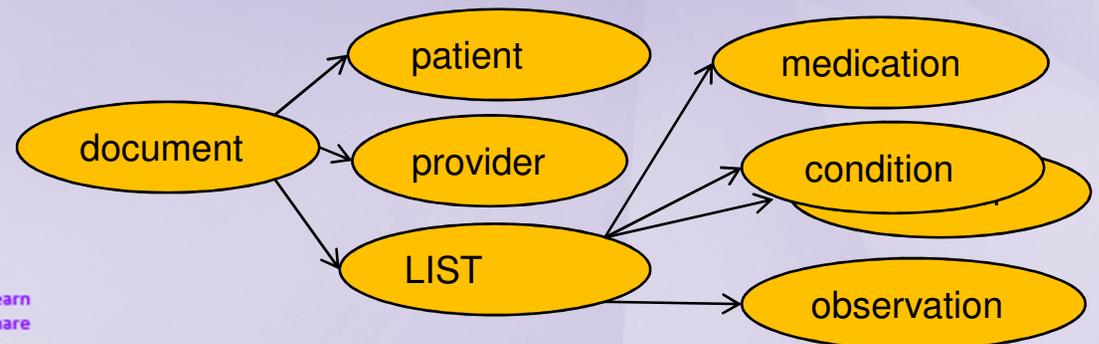
GET http://myfhirserver.com/encounter/404?_include=patient



PUT <http://myfhirserver.com/encounter/707> {XML or JSON Resource expression}



GET <http://myfhirserver.com/document/800511>



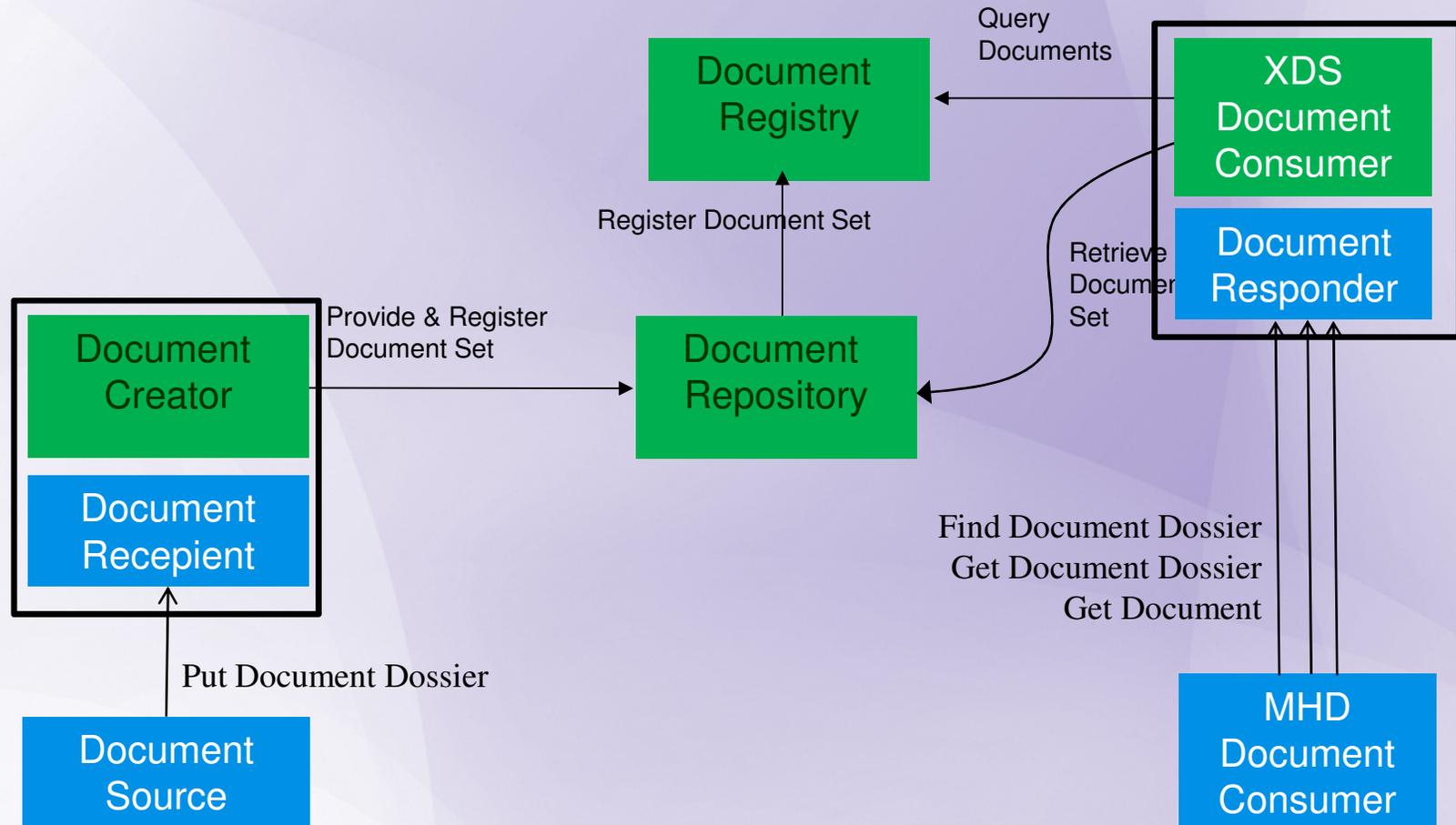


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IHE MHD

Mobile access to
Health Documents

IHE XDS/MHD Profiles



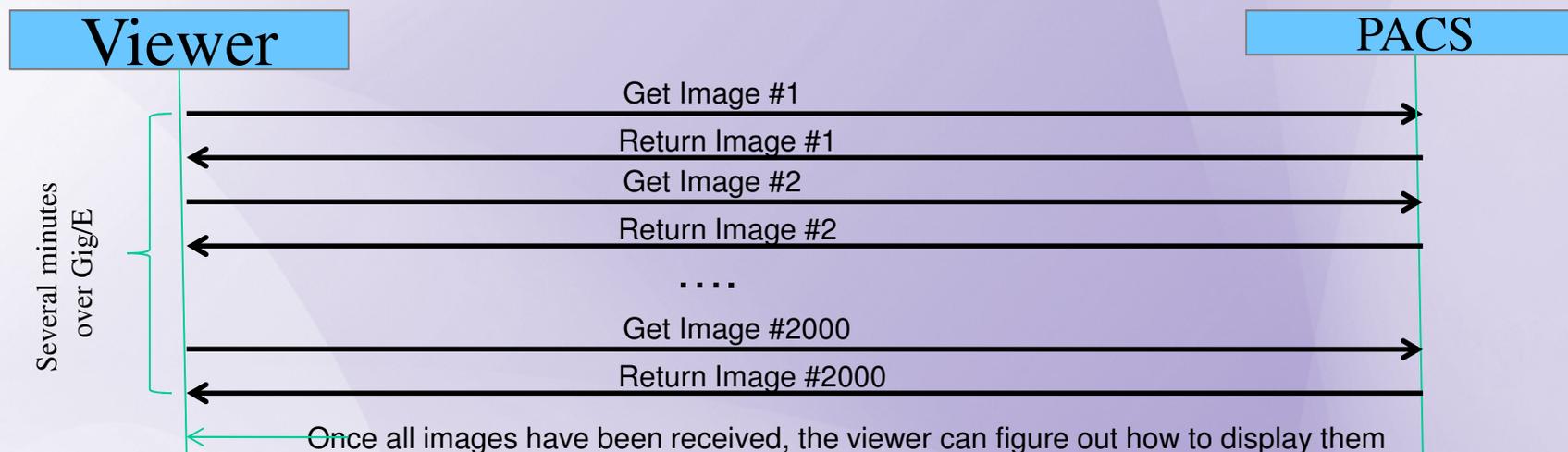


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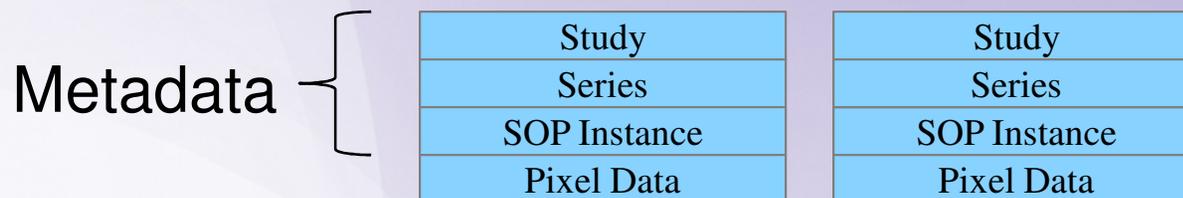
DICOM

RESTful DICOM Protocols

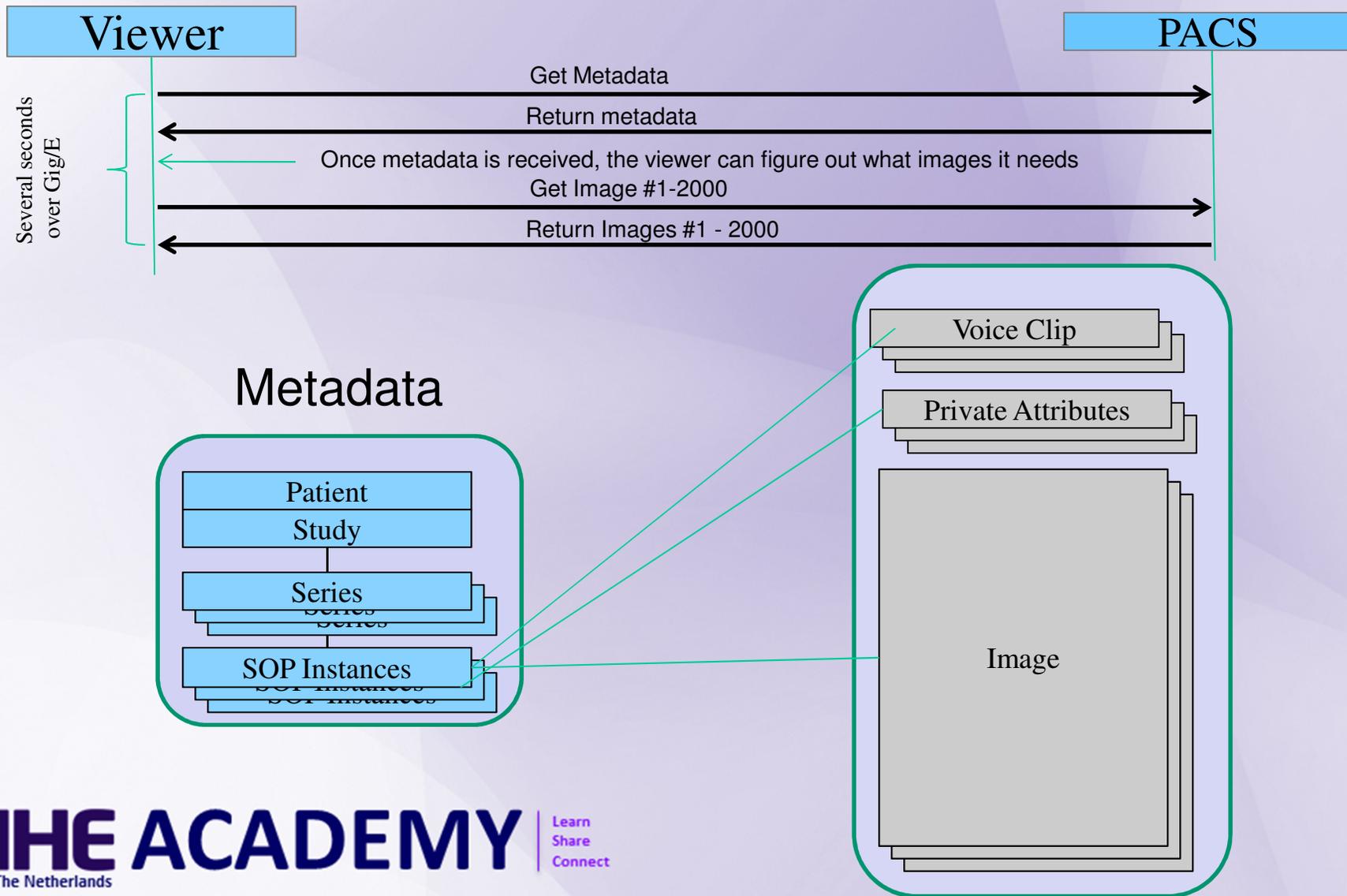
Traditional DICOM Transport



Transmission is organized at the SOP Instance level:



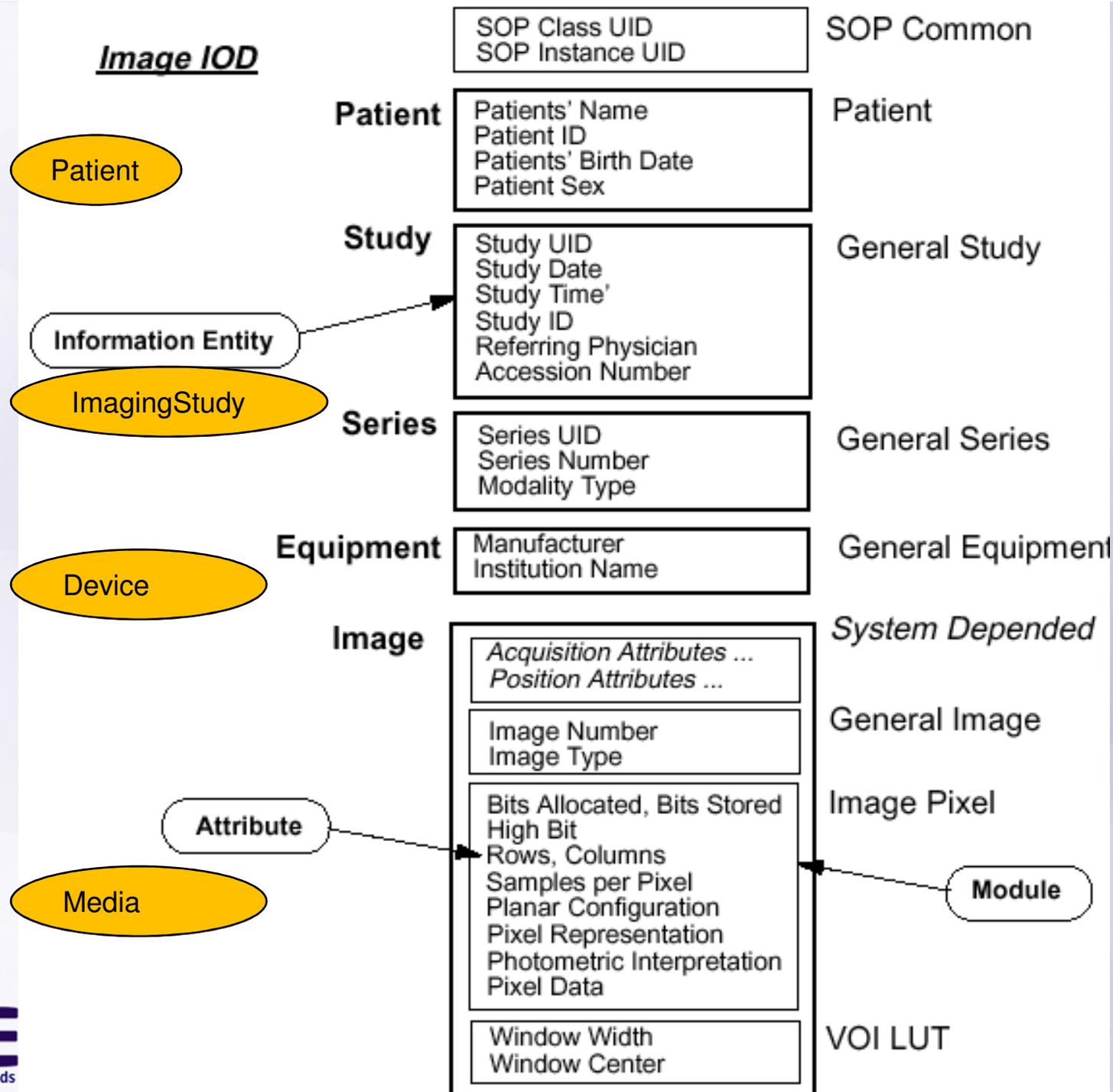
RESTful DICOM Transport



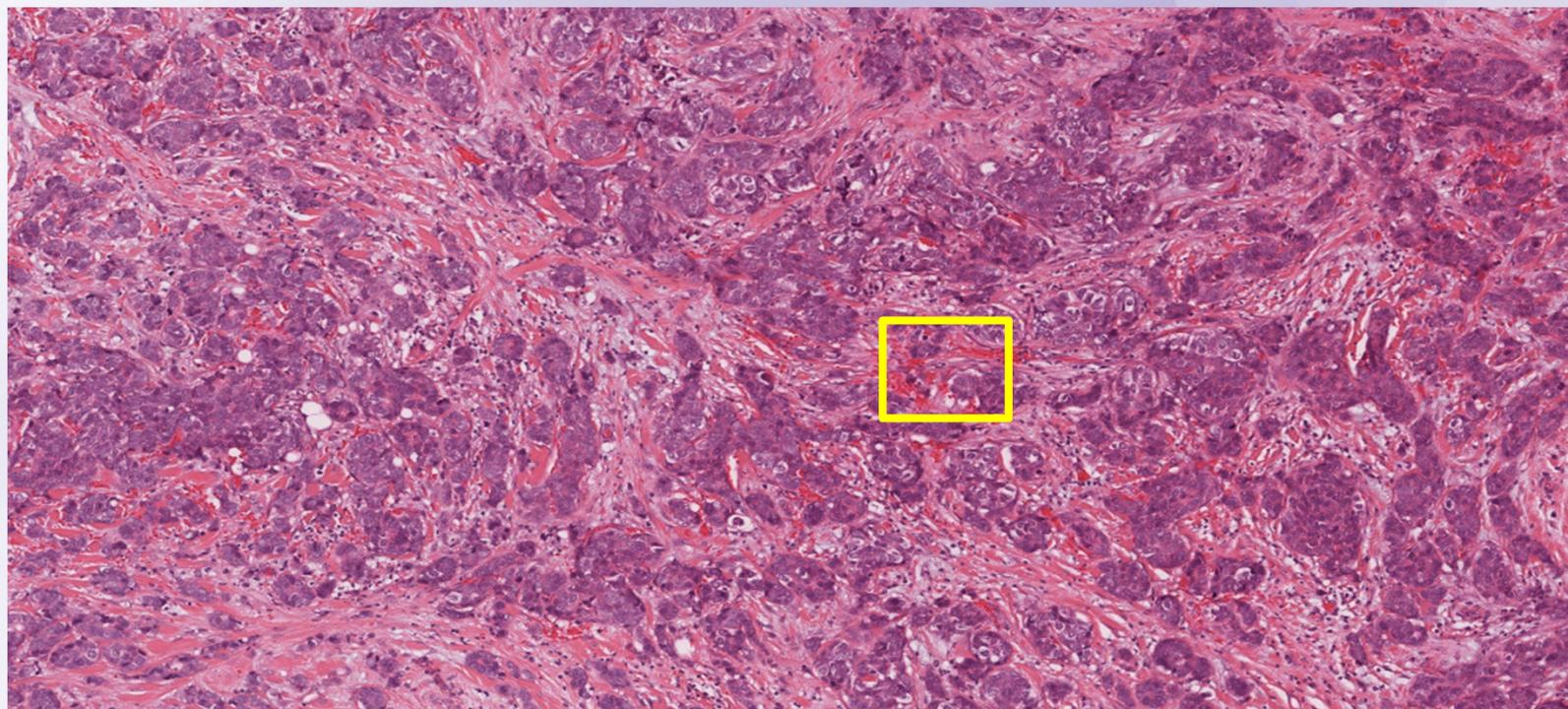
Putting it together...

- Metadata separated from image data
- Fetch
 - Simple URL-based search (UID based)
 - Parse XML or JSON response
 - Launch viewer for selected study
 - Download metadata, subset of images
 - Download rest of study in background
- Upload
 - new evidence / artifacts, entire studies

Image IOD

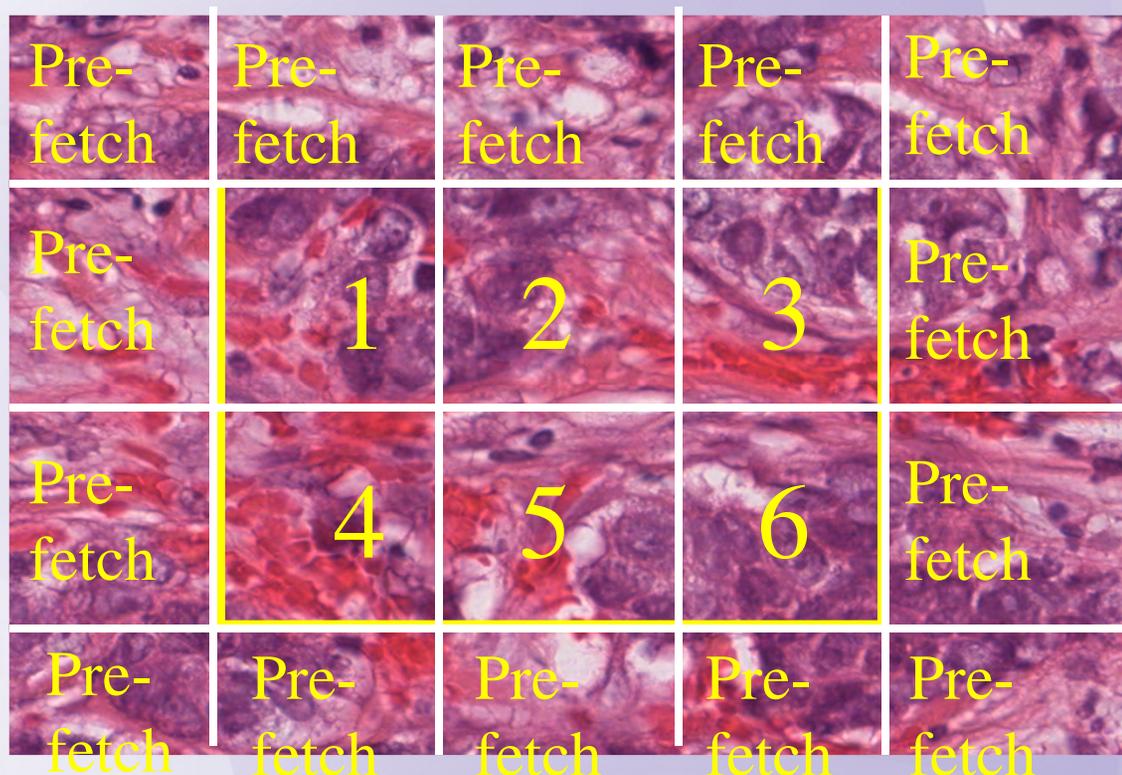


Example: Mobile Digital Pathology



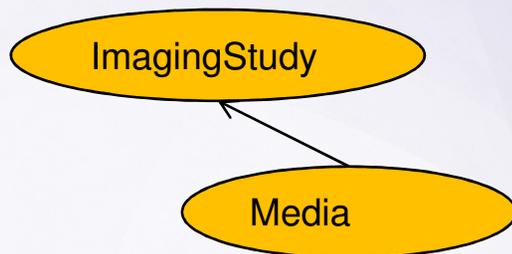
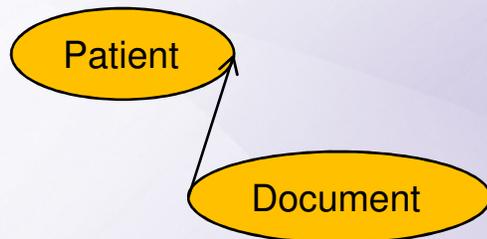
- Full X20 image, 60000x40000 pixels (7Gb, 200Mb compressed)
- This view: 1000x550 pixels

Mobile Digital Pathology



1. <http://mypacs.net/image/1234?region=27800,17200,27900,17400&res=300>
 2. <http://mypacs.net/image/1234?region=27900,17200,28000,17400&res=300>
 3. <http://mypacs.net/image/1234?region=28000,17200,28100,17400&res=300>
 4. <http://mypacs.net/image/1234?region=27800,17400,27900,17600&res=300>
- Etc. etc.

FHIR+MHD+RESTful DICOM



- Fetch Patient (FHIR)
- Fetch Documents (MHD)
 - Documents could reference (by URL on a different server):
 - a FHIR Patient and Encounter,
 - a DICOM Image
- Fetch Images (RESTful DICOM)
 - Image could reference (by URL on a different server):
 - a FHIR Patient

Status of these standards

- IHE MHD: 'trial implementation' status
 - www.ihe.net/Technical_Frameworks
- HL7 FHIR: 'draft standard for trial use'
 - www.hl7.org/fhir
- RESTful DICOM (sup 161, 163, 166):
final
 - medical.nema.org

The logo for IHE The Netherlands. It features the letters 'IHE' in a large, bold, dark blue font. Below 'IHE', the words 'The Netherlands' are written in a smaller, dark blue font. A vertical line is positioned to the right of the text.

IHE
The Netherlands

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Questions ?