

RESTful Services in the Context of Medical Imaging

Brad Genereaux

Agfa HealthCare

DICOM WG-27 Industry Co-Chair

What is a RESTful service?

- Architectural style for web communication
 - Scalable, fault-tolerant, recoverable, secure, and loosely-coupled



Resources

Resource	Returns
/patients	A list of all patients
/patients/bob	Details about “Bob”
/patients/bob/reports	A list of all Bob’s reports
/patients/bob/reports/1	Details about Bob’s first report

i.e., <http://myserver.com/patients/bob>

Verbs

Verb	Results
GET /patients/bob	Returns details about Bob
POST /patients/bob	Creates a new Bob with an ID of 1
PUT /patients/bob	Updates Bob with new information
DELETE /patients/bob	Deletes Bob

i.e., GET <http://myserver.com/patients/bob>

When do we use RESTful services?

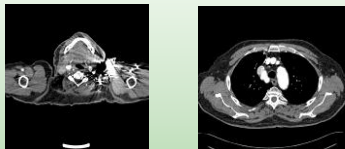
- When we want to deliver content over the web, securely and efficiently
- When we have a diverse community of consumers of our service

“555” Rule

- 5 seconds to find the documentation
- 5 minutes to make a Hello World app using the API
- 5 hours to a working prototype

Medical Imaging outside Radiology

Foreign studies



Regional archives



Non-DICOM modalities



EHR / EMR



Mobile Devices



Sharing Portals



Why Medical Imaging for Web?

- Becomes possible to consume content directly by clients (browsers, mobile)
 - No “special tools” required
 - Minimize what is transferred
- Allows for rapid development and consumption of content
- Frees content from closed systems and spawns integrations into today’s technologies

History of Medical Imaging on the Web

- WADO (Web Access to DICOM Objects) was created in 2003, providing object level access only
- MINT (Medical Imaging Network Transport) was created ~2011 (not part of DICOM) out of a recognition of the importance of REST transport
- DICOMweb™ was thus developed, and resources have been added ever since

Building DICOMweb™ as Services Set

Query

- **QIDO-RS (Query based on ID for DICOM Objects)**
- DICOM PS3.18 6.7

Retrieve

- **WADO-RS (Web Access of DICOM Objects)**
- DICOM PS3.18 6.5

Store

- **STOW-RS (Store over the web)**
- DICOM PS3.18 6.6

Tasks

- **UPS-RS (Worklist Service)**
- DICOM PS3.18 6.9

Server Info

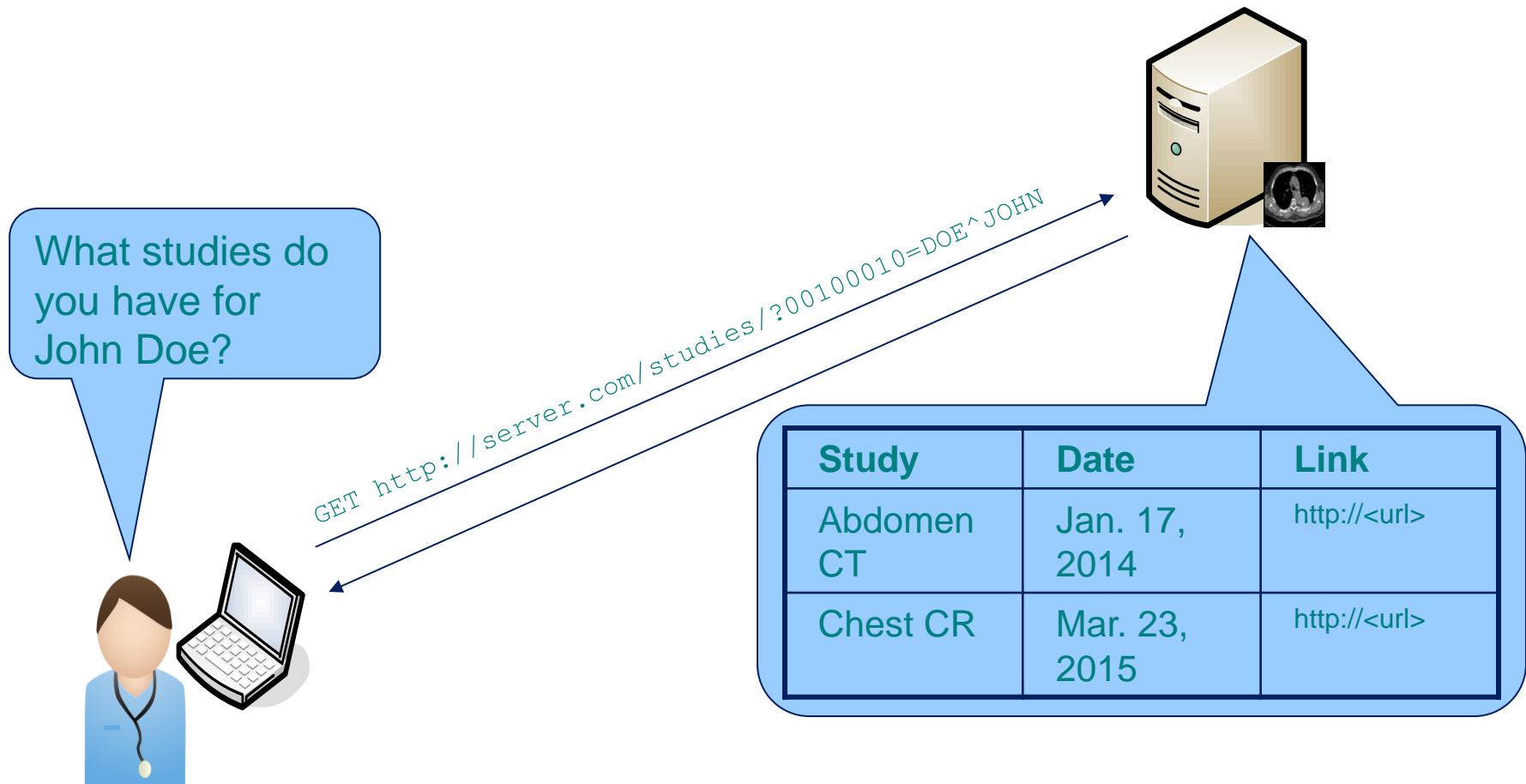
- **Capabilities Service**
- DICOM PS3.18 6.8

Medical Imaging Resources

Verb	Path
POST	{s}/studies
GET	{s}/studies?...
GET	{s}/studies/{studyUID}
POST	{s}/studies/{studyUID}
GET	{s}/studies/{studyUID}/metadata
GET	{s}/studies/{studyUID}/series?...
GET	{s}/studies/{studyUID}/series/{seriesUID}
GET	{s}/studies/{studyUID}/series/{seriesUID}/ metadata
GET	{s}/studies/{studyUID}/series/{seriesUID}/ instances?...
GET	{s}/studies/{studyUID}/series/ {seriesUID}/instances/{instanceUID}
GET	{s}/studies/{studyUID}/series/ {seriesUID}/instances/{instanceUID}/ metadata
GET	{s}/studies/{studyUID}/series/{seriesUID}/ instances/{instanceUID}/ frames/{frames}
GET	/{bulkdataReference}

Verb	Path
POST	{s}/workitems{?AffectedSOPInstanceUID}
POST	{s}/workitems/{UPSInstanceUID}{?transaction}
GET	{s}/workitems{?query*}
GET	{s}/workitems/{UPSInstanceUID}
PUT	{s}/workitems/{UPSInstanceUID}/state
POST	{s}/workitems/{UPSInstanceUID}/cancelrequest
POST	{s}/workitems/{UPSInstanceUID}/subscribers/ {AETitle}{?deletionlock}
POST	{s}/workitems/1.2.840.10008.5.1.4.34.5/
DELETE	{s}/workitems/{UPSInstanceUID}/ subscribers/{AETitle}
GET	{s}/subscribers/{AETitle}

DICOMweb™ Query Example



DICOMweb™ Data Structures

```
<DicomAttribute Tag="00080020" VR="DT" Keyword="StudyDate">
  <Value number="1">20130409</value>
</DicomAttribute>
<DicomAttribute Tag="00080061" VR="CS" Keyword="ModalitiesInStudy">
  <Value number="1">CT</value>
</DicomAttribute>
<DicomAttribute Tag="00100010" VR="PN" Keyword="PatientName">
  <PersonName number="1">
    <SingleByte>
      <FamilyName>Doe</FamilyName>
      <GivenName>John</GivenName>
    </PersonName>
  </DicomAttribute>
<DicomAttribute Tag="0020000D" VR="UI" Keyword="StudyInstanceUID">
  <Value number="1">
    1.2.392.200036.9116.2.2.2.1762893313.1029997326.945873
  </Value>
</DicomAttribute>
```

XML

```
"00080020": {
  "vr": "DT", "Value": ["20130409"]
},
"00080061": {
  "vr": "CS", "Value": "CT"
},
"00100010": {
  "vr": "PN", "Value": [ {
    "Alphabetic": {
      "Family": ["Doe"], "Given": ["John"]
    }
  }
],
"0020000D": {
  "vr": "UI", "Value": [
    "1.2.392.200036.9116.2.2.2.1762893313.1029997326.945873"
  ]
}
```

JSON

Where do I find more information?

- DICOM Main Site
 - <http://dicom.nema.org>
- DICOMweb™ Reference
 - PS3.18 <http://goo.gl/bIFHV3>
 - <http://dicomweb.org>
- Participate in DICOM
 - <http://goo.gl/c8s3bK>