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## **Digital Imaging and Communications in Medicine (DICOM)**

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### *Supplement 166: Query based on ID for DICOM Objects by Representational State Transfer (REST) Services (QIDO-RS)*

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## Scope and Field of Application

132 This Supplement defines Representational State Transfer (REST) Services for querying a server for  
133 DICOM studies, series and instances. This could be implemented as a proxy to an existing C-FIND service  
134 or as a web service interacting directly with a PACS, Vendor Neutral Archive or other searchable DICOM  
application.

136 Additionally, this supplement defines a DICOM JavaScript Object Notation (JSON) representation.

RESTful change management mechanisms are not defined within this supplement.

138 Security is beyond the scope of the RESTful services defined in this supplement. However generic Web  
139 security mechanisms are fully compatible. Several security programming recipes are provided for  
140 reference.

142 **Changes to NEMA Standards Publication PS 3.2-2011**

**Digital Imaging and Communications in Medicine (DICOM)**

144 **Part 2: Conformance**

**Append after PS 3.2 Annex J (Informative) CONFORMANCE STATEMENT SAMPLE QIDO SERVICE**

146 **ANNEX X (Informative) CONFORMANCE STATEMENT  
SAMPLE QIDO-RS PROVIDER**

148 Disclaimer:

This document is an example DICOM Conformance Statement for a fictional application service called  
150 EXAMPLE-QIDO-SERVICE produced by a fictional vendor called EXAMPLE-PACS-PRODUCTS.

As stated in the annex title, this document is truly informative, and not normative. A conformance  
152 statement of an actual product might implement additional services and options as appropriate for its  
specific purpose. In addition, an actual product might implement the services described in a different  
154 manner and, for example, with different characteristics and/or sequencing of activities. In other words, this  
conformance statement example does not intend to standardize a particular manner that a product might  
156 implement DICOM functionality.

**X.0 COVER PAGE**

158 Company Name: EXAMPLE-PACS-PRODUCTS

160 Product Name: EXAMPLE-QIDO-SERVICE

162 Version: 1.0-rev. A.1

164 Internal document number: 1024-xxx-yyy-zzz rev 1

166 Date: YYYYMMDD

168 **X.1 CONFORMANCE STATEMENT OVERVIEW**

170 This fictional product EXAMPLE-QIDO-SERVICE implements QIDO-RS, which allow the client to search for studies, series or SOP instances stored in an EXAMPLE-PACS-ARCHIVE. The EXAMPLE- QIDO-SERVICE is only available as a plug in option for the EXAMPLE-PACS-ARCHIVE. All of the networking, database, and other services are provided by the EXAMPLE-PACS-ARCHIVE. This conformance claim refers to the conformance claim for the EXAMPLE-PACS-ARCHIVE for all such services.

174 Table X.1-1 provides an overview of the network services supported by EXAMPLE-QIDO-SERVICE.

176 **Table X.1-1  
 NETWORK SERVICES**

| Network Service                             | User of Service (Client) | Provider of Service (Server) |
|---|--------------------------|------------------------------|
| <b>Query by ID for DICOM Objects (QIDO)</b> |                          |                              |
| QIDO-RS – Search for Studies                | No                       | Yes                          |
| QIDO-RS – Search for Series                 | No                       | Yes                          |
| QIDO-RS – Search for Instances              | No                       | Yes                          |

178 **X.2 TABLE OF CONTENTS**

A table of contents shall be provided to assist readers in easily finding the needed information.

180 **X.3 INTRODUCTION**

**X.3.1 Revision History**

| Document Version | Date of Issue    | Author | Description            |
|------------------|------------------|--------|------------------------|
| 1.1              | October 24, 2011 | WG-27  | Version for Final Text |
| 1.2              | March 26, 2013   | WG-27  | Revised Introduction   |

182

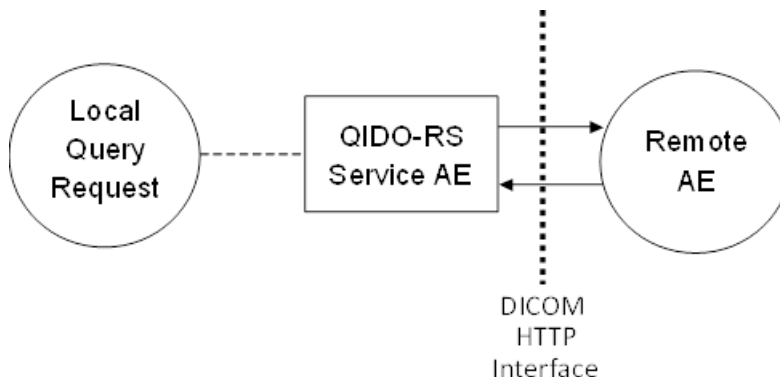
184 **X.3.2 AUDIENCE, REMARKS, TERMS AND DEFINITIONS, BASICS OF DICOM COMMUNICATION, ABBREVIATIONS, REFERENCES**

*See example text in Annex A.3.*

186 **X.3.3 ADDITIONAL REMARKS FOR THIS EXAMPLE**

188 This document is a sample DICOM Conformance Statement created for DICOM PS 3.2. It is to be used solely as an example to illustrate how to create a DICOM Conformance Statement for a DICOM Service Class Provider (SCP). The subject of the document, EXAMPLE-QIDO-SERVICE, is a fictional product.

190 **X.4 NETWORKING**  
**X.4.1 IMPLEMENTATION MODEL**  
 192 **X.4.1.1 Application Data Flow**



194 **Figure X.4.1-1 Application Data Flow Diagram**

196 The QIDO-RS Provider Application receives QIDO requests from a remote AE. These requests are  
 198 the request to select matching Studies, Series or Instances. It then returns a set of matching Studies,  
 Series or Instances or a response code indicating warning or failure back to the requesting device.

200 **X.4.1.2 Functional Definition of AEs**  
**X.4.1.2.1 Functional Definition of QIDO Service Application**

202 The reception of a QIDO-RS GET request will activate the QIDO-RS Provider. An internal query request is  
 204 is based upon the URL of the QIDO-RS GET request. The response is a status code indicating the  
 206 VNA.

**X.4.2 AE SPECIFICATIONS**

208 This AE complies with PS 3.18, Section 6.7, specification for QIDO-RS.

**X.4.2.1 QIDO-RS Specifications**

210 **X.4.2.1.1 QIDO-RS Search For Studies**

212 **Table X.4.2-1 QIDO-RS SEARCH FOR STUDIES Specification**

| Parameter                  | Restrictions  |
|----------------------------|---|
| Media Types                | Restricted to "multipart/related; type=application/dicom+xml" or "application/json" |
| Matching Attributes        | See Table X.4.2-1a  |
| Return Attributes          | See Table X.4.2-1a  |
| Limit and Offset supported | Yes   |
| Person Name Matching       | Literal, case insensitive. See X.4.2.2 Extended Negotiation.                        |



214

**Table X.4.2-1a**  
**QIDO-RS STUDY attribute matching**

| Key Word                          | Tag      | Types of Matching |
|-----------------------------------|----------|-------------------|
| <b>STUDY Level</b>                |          |                   |
| StudyDate                         | 00080020 | S,*,U,R           |
| StudyTime                         | 00080030 | S,*,U,R           |
| AccessionNumber                   | 00080050 | S,*,U             |
| ModalitiesInStudy                 | 00080061 | S,*,U             |
| ReferringPhysiciansName           | 00080090 | S,*,U             |
| StudyDescription                  | 00081030 | S,*,U             |
| PhysicianOfRecord                 | 00081048 | U                 |
| PatientsName                      | 00100010 | S,*,U             |
| PatientID                         | 00100020 | S,*,U             |
| PatientBirthDate                  | 00100030 | NONE              |
| PatientSex                        | 00100040 | NONE              |
| StudyInstanceUID                  | 0020000D | UNIQUE            |
| StudyID                           | 00200010 | S,*,U             |
| NumberOfStudyRelatedSeries        | 00201206 | NONE              |
| NumberOfStudyRelatedInstances     | 00201208 | NONE              |
| RetrieveURL                       | 00081190 | NONE              |
| <b>Common to all query levels</b> |          |                   |
| InstanceAvailability              | 00080056 | S,*,U             |
| SpecificCharacterSet              | 00080005 | NONE              |
| RetrieveURL                       | 00081190 | NONE              |

216

Types of Matching (see PS 3.4 C.2.2.2):

218 "S" indicates the identifier attribute uses Single Value Matching

"L" indicates UID List Matching

220 "U" indicates Universal Matching.

222 Note: If **only** Universal Matching is supported for an attribute then that attribute can only be passed as an "includefield" query key

"\*" indicates wildcard matching

224 "R" indicates Range Matching

"SEQUENCE" indicates Sequence Matching

226 "NONE" indicates that no matching is supported, but that values for this Element requested will be returned with all requests

228 "UNIQUE" indicates that this is the Unique Key for that query level, in which case Universal Matching or Single Value Matching is used depending on the query level (see PS 3.4 C.2.2.1.1).

230

**X.4.2.1.2 QIDO-RS Search For Series**

232

**Table X.4.2-2  
QIDO-RS SEARCH FOR SERIES Specification**

| Parameter                    | Restrictions  |
|------------------------------|---|
| Media Types                  | Restricted to “multipart/related; type=application/dicom+xml” or “application/json” |
| Matching Attributes          | See Table X.4.2-2a  |
| Return Attributes            | See Table X.4.2-2a  |
| Limit and Offset supported   | Yes   |
| Relational Queries Supported | No  |

234

236

**Table X.4.2-2a  
QIDO-RS SERIES attribute matching**

| Key Word                          | Tag      | Types of Matching |
|-----------------------------------|----------|-------------------|
| <b>SERIES Level</b>               |          |                   |
| Modality                          | 00080060 | S,*,U             |
| SeriesDescription                 | 0008103E | NONE              |
| SeriesInstanceUID                 | 0020000E | UNIQUE            |
| SeriesNumber                      | 00200011 | S,*,U             |
| NumberOfSeriesRelatedInstances    | 00201209 | NONE              |
| PerformedProcedureStepStartDate   | 00400244 | S,*,U,R           |
| PerformedProcedureStepStartTime   | 00400245 | S,*,U,R           |
| RequestAttributeSequence          | 00400275 | SEQUENCE          |
| >ScheduledProcedureStepID         | 00400009 | S,*,U             |
| >RequestedProcedureID             | 00401001 | S,*,U             |
| <b>Common to all query levels</b> |          |                   |
| InstanceAvailability              | 00080056 | S,*,U             |
| SpecificCharacterSet              | 00080005 | NONE              |
| RetrieveURL                       | 00081190 | NONE              |

238 Types of matching: see X.4.2.1.1 QIDO-RS SearchForStudies.

**X.4.2.1.3 QIDO-RS Search For Instances**

240

**Table X.4.2-3  
QIDO-RS SEARCH FOR INSTANCES Specification**

| Parameter           | Restrictions  |
|---------------------|---|
| Media Types         | Restricted to “multipart/related; type=application/dicom+xml” or “application/json” |
| Matching Attributes | See Table X.4.2-3a  |

| Parameter                    | Restrictions       |
|------------------------------|--------------------|
| Return Attributes            | See Table X.4.2-3a |
| Limit and Offset supported   | Yes                |
| Relational Queries Supported | Series-level, only |

242

**Table X.4.2-3a**

**QIDO-RS INSTANCE attribute matching**

244

| Key Word                          | Tag      | Types of Matching |
|-----------------------------------|----------|-------------------|
| <b>SERIES Level</b>               |          |                   |
| Modality                          | 00080060 | S,*,U             |
| SeriesDescription                 | 0008103E | NONE              |
| SeriesInstanceUID                 | 0020000E | UNIQUE            |
| SeriesNumber                      | 00200011 | S,*,U             |
| NumberOfSeriesRelatedInstances    | 00201209 | NONE              |
| PerformedProcedureStepStartDate   | 00400244 | S,*,U,R           |
| PerformedProcedureStepStartTime   | 00400245 | S,*,U,R           |
| RequestAttributeSequence          | 00400275 | SEQUENCE          |
| >ScheduledProcedureStepID         | 00400009 | S,*,U             |
| >RequestedProcedureID             | 00401001 | S,*,U             |
| <b>COMPOSITE INSTANCE Level</b>   |          |                   |
| SOPClassUID                       | 00080016 | L                 |
| SOPInstanceUID                    | 00080018 | UNIQUE            |
| InstanceNumber                    | 00200013 | S,*,U             |
| Rows                              | 00280010 | NONE              |
| Columns                           | 00280011 | NONE              |
| BitsAllocated                     | 00280100 | NONE              |
| NumberOfFrames                    | 00280008 | NONE              |
| <b>Common to all query levels</b> |          |                   |
| InstanceAvailability              | 00080056 | S,*,U             |
| SpecificCharacterSet              | 00080005 | NONE              |
| RetrieveURL                       | 00081190 | NONE              |

246 Types of matching: see X.4.2.1.1 QIDO-RS SearchForStudies.

**X.4.2.1.4 Connection Policies**

248 **X.4.2.1.4.1 General**

All standard RS connection policies apply. There are no extensions for RS options.

250 **X.4.2.1.4.2 Number of Connections**

252 EXAMPLE-QIDO-SERVICE limits the number of simultaneous RS requests. Additional requests will be queued after the HTTP/1.1 connection is accepted. When an earlier request completes, a pending request will proceed.

254 **Table X.4.2-4  
Number of HTTP/1.1 requests supported**

|  |                    |
|--|--------------------|
| Maximum number of simultaneous RS requests | 100 (configurable) |
|--|--------------------|

256

**X.4.2.1.4.3 Asynchronous Nature**

258 EXAMPLE-QIDO-SERVICE does not support RS asynchronous response.

**X.4.2.1.4.4 Response Status**

260 The EXAMPLE-QIDO-SERVICE shall provide a response message header containing the appropriate status code indicating success, warning, or failure as shown in Table 4.2-5.

262

**Table 4.2-5  
HTTP/1.1 STANDARD Response Codes**

| Code    | Name                     | Description   |
|---------|--------------------------|---|
| Success |                          |   |
| 200     | OK                       | The query completed and any matching results are returned in the message body.  |
| Failure |                          |   |
| 400     | Bad Request              | This indicates that the QIDO-RS Provider was unable to fulfill it because it cannot understand the query component.   |
| 401     | Unauthorized             | This indicates that the QIDO-RS Provider refused to fulfill it because the client is not authorized.  |
| 403     | Forbidden                | This indicates that the QIDO-RS Provider understood the request, but is refusing to fulfill it (e.g. no single patient specified, an authorized user with insufficient privileges, etc.). |
| 413     | Request entity too large | This indicates that the query was too broad and a narrower query or paging should be requested. This code will be returned for queries that do not specify PatientID.                     |
| 503     | Busy                     | Service is unavailable.   |

264

**X.4.2.2 Extended Negotiation**

266 EXAMPLE-QIDO-SERVICE does not support the "fuzzymatching" query key.

268 EXAMPLE-QIDO-SERVICE will perform case insensitive matching for PN VR attributes but will not perform other forms of fuzzy matching. This applies to the following attributes:

- Referring Physician's Name (0008,0090)
- 270 — Physician(s) of Record (0008,1048)
- Patient's Name (0010,0010)

272

### **X.4.3 NETWORK INTERFACES**

#### **274 X.4.3.1 Physical Network Interface**

276 EXAMPLE-QIDO-SERVICE uses the network interface from the hosting EXAMPLE-PACS-ARCHIVE. See its conformance claim for details.

#### **X.4.3.2 Additional Protocols**

278 EXAMPLE-QIDO-SERVICE uses the network services from the hosting EXAMPLE-PACS-ARCHIVE. See its conformance claim for details.

#### **280 X.4.3.3 IPv4 and IPv6 Support**

This product supports both IPv4 and IPv6 connections.

### **282 X.4.4 CONFIGURATION**

#### **X.4.4.1 QIDO-RS Interface**

284 The EXAMPLE-QIDO-SERVICE can be configured to respond on one port for TLS protected traffic. The TLS port will refuse any connection from a system that is not recognized as authenticated by a known authority.  
286

### **X.5 MEDIA INTERCHANGE**

288 Not applicable

### **X.6 SUPPORT OF CHARACTER SETS**

290 EXAMPLE-QIDO-SERVICE supports Unicode UTF-8 for all RS transactions.

292 See conformance claim for EXAMPLE-PACS-ARCHIVE for character sets used within the DICOM instances.

### **X.7 SECURITY**

294 The EXAMPLE-QIDO-SERVICE supports the following transport level security measures:

- HTTP BASIC Authorization over SSL
- 296 — Digest Authorization
- SSL Client Certificates

298

300 The transport level security measures support bi-directional authentication using TLS connections. The EXAMPLE-QIDO-SERVICE can provide its certificate information, and can be configured with either a direct comparison (self-signed) certificate or a chain of trust certificate.

302 The EXAMPLE-QIDO-SERVICE will refuse a connection over TLS from a source that does not have a recognized authentication. For example, a certificate authenticated by "Big Hospital Provider." will not be  
304 accepted unless the EXAMPLE-QIDO-SERVICE has been configured to accept authentications from "Big

306 Hospital Provider." The list of acceptable certificates for EXAMPLE-QIDO-SERVICE is not shared with certificates used by other system applications and must be maintained independently.

308 The EXAMPLE-QIDO-SERVICE can optionally be configured to use the following session authentication mechanisms:

- Kerberos Local Domain Sessions
- 310 — Shibboleth Cross Domain Sessions (using SAML2.0)
- OAuth 2.0 complying with IHE ITI Internet User Authentication (IUA) Profile

312

## Changes to NEMA Standards Publication PS 3.17-2012

### 314 Digital Imaging and Communications in Medicine (DICOM)

#### Part 17: Explanatory Information

#### 316 Update to PS 3.2 Section 4 Symbols and Abbreviations

### 4 SYMBOLS AND ABBREVIATIONS

318 The following symbols and abbreviations are used in this Part.

#### **FHIR** **HL7 Fast Healthcare Interoperability Resources (draft standard)**

320

#### Append below PS 3.17 Annex HHH.3

#### 322 **HHH.4 USES FOR QIDO SERVICES**

##### **HHH.4.1 General requirements**

324 Imaging information is important in the context of EMR/EHR. But EMR/EHR systems often do not support  
326 DICOM service classes. The EMR/EHR vendors need access using web and web service technologies to  
satisfy their users.

##### **HHH.4.2 Analysis of use cases**

328 Examples of use cases / clinical scenarios, used as the basis for the development of the QIDO-RS  
requirements, include:

- 330 a. Search from EMR
- b. Populating FHIR resources
- 332 c. Worklist in Viewer
- d. Study Import Duplication Check
- 334 e. Multiple System Query
- f. Clinical Reconstruction
- 336 g. Mobile Device Access

##### 338 **HHH.4.2.1 Search from EMR**

A General Practitioner (GP) in a clinic would like to check for imaging studies for the current patient. These  
340 studies are stored in a PACS, Vendor Neutral Archive (VNA) or HIE that supports QIDO functionality. The  
GP launches an Electronic Medical Record (EMR) application, and keys in the patient demographics to  
342 search for the patient record within the EMR. Once the record is open, the EMR, using QIDO, makes  
requests to the back-end systems, supplying Patient ID (including issuer) and possibly other parameters  
344 (date of birth, date range, modality, etc.). That system returns the available studies along with meta-data

346 for each study that will help the GP select the study to open. The meta-data would include, but is not limited to, Study Description, Study Date, Modality, and Referring Physician.

#### 348 **HHH.4.2.2 Populating FHIR resources**

348 HL7 has introduced FHIR (Fast Healthcare Interoperability Resources) as a means of providing access to healthcare informatics information using RESTful web services.

350 While FHIR will not replicate the information contained in a PACS or other medical imaging storage system, it is desirable for FHIR to present a view of the medical imaging studies available for a particular patient along with the means of retrieving the imaging data using other RESTful services.

#### 352 **HHH.4.2.3 Worklist in Viewer**

354 A Radiologist, is reading studies in the office, using software that maintains diagnostic orders for the facility. This system produces the radiology worklist of studies to be read and provides meta-data about each scheduled procedure, including the Study Instance UID. When the next study is selected to be read on the worklist, the system, using the Study Instance UID, makes a QIDO request to the local archive to discover the instances and relevant study meta-data associated with the procedure to display. Subsequent QIDO requests are made to the local archive and to connected VNA archives to discover candidate relevant prior studies for that patient.

362 For each candidate relevant prior, the full study metadata will be retrieved using WADO-RS and processed to generate the list of relevant priors.

#### **HHH.4.2.4 Multiple Systems Query**

364 A Radiologist is working in a satellite clinic, which has a system with QIDO functionality and small image cache. The main hospital with which the clinic is affiliated has a system with QIDO functionality and a large historical image archive or VNA. The viewing software displays a worklist of patients, and a study is selected for viewing. The viewer checks for prior studies, by making QIDO requests to both the local cache and remote archive using the Patient ID, Name and Date of Birth, if available. If the Patient Identifier isn't available, other means (such as by other demographics, or a Master Patient Index) could be utilized. Any studies that meet relevant prior criteria can be pre-fetched.

#### **HHH.4.2.5 Clinical Reconstruction**

372 A Neurologist is preparing a surgical plan for a patient with a brain tumor using three-dimensional reconstruction software which takes CT images and builds a 3D model of various structures. After supplying the patient demographics (or Patient Identifier), the software requests a list of appropriate studies for reconstruction (based on Study Date, Body Region and Modality). Once the user has selected a study and series, the software contacts the QIDO server again, requesting the SOP Instance UIDs of all images of a certain thickness (specified in specific DICOM tags) and frame of reference to be returned. The software then uses this information to retrieve, using the WADO-RS service, the appropriate DICOM objects needed to prepare the rendered volume for display.

#### 380 **HHH.4.2.6 Mobile Device Access**

382 A General Practitioner (GP) has left the medical ward for a few hours, and is paged with a request to look at a patient X-Ray image in order to grant a discharge. The GP carries a smart phone which has been pre-loaded with credentials and secured. The device makes a QIDO request to the server, to look for studies from the last hour that list the GP as the Referring Physician. The GP is able to retrieve and view the matching studies, and can make a determination whether to return to the ward for further review or to sign the discharge order using the phone.



### HHH.4.3 Description of the Use Cases

388 The use cases described above in terms of clinical scenarios correspond to the following technical  
implementation scenarios. In each case the use is distinguished by the capabilities of the requesting  
390 system:

- a. Does it prefer XML or JSON results?
- 392 b. Does it need to perform searches at the Series and Instance level or can it process the full  
Study metadata?
- 394 c. What attributes does it need to search against?
- d. What attributes does it need for each matching Study, Series or Composite Instance?

396

These questions can be applied to the use cases:

- 398 a. Search from EMR
  - 1. JSON or XML
  - 400 2. Study
  - 3. Study Instance UID, Patient ID
  - 402 4. Accession Number, Issuer of Accession Number, Study Description, Study Date, Modality,  
Number of Series, Number of Instances
- 404 b. Populating FHIR resources
  - 1. JSON or XML
  - 406 2. Study, Series and Instance
  - 3. Patient ID and Issuer of Patient ID
  - 408 4. All attributes required by the FHIR Imaging Study Resource (see  
<http://www.hl7.org/implement/standards/fhir/imagingstudy.htm>)
- 410 c. Worklist in Viewer
  - 1. JSON or XML
  - 412 2. Study
  - 3. Study Instance UID, Patient ID, Issuer of Patient ID
  - 414 4. Series Instance UIDs, SOP Instance UIDs, patient demographics, Study Description,  
Study Date, Modality, Referring Physician
- 416 d. Study Import Duplication Check
  - 1. JSON or XML
  - 418 2. Study
  - 3. Study Instance UID, Series Instance UID, SOP Instance UID
  - 420 4. Study Instance UID
- e. Multiple System Query
  - 422 1. JSON or XML
  - 2. Study
  - 424 3. Patient ID, Issuer of Patient ID, Patient Name, Patient Date of Birth
  - 426 4. Study Instance UID, Accession Number, Study Description, Study Date, Modalities in  
Study
- f. Clinical Reconstruction
  - 428 1. JSON or XML
  - 2. Study, Series, Instance

- 430           3. Study Instance UID, Series Instance UID
- 4. SOP Instance UID, Image Instance Level Attributes
- 432           g. Mobile Device Access
- 1. JSON
- 434           2. Study, Series and Instance
- 3. Patient ID, Issuer of Patient ID, Patient Name, Patient Date of Birth, Study Date, Referring Physician
- 436           4. Instance Date/time, Modalities in Study
- 438

These then become the following technical use cases.

#### 440 **HHH.4.3.1 XML Study Search Use Case**

- 442           a. The requesting web-based application can make QIDO-RS requests, parse XML and then make WADO-RS requests
- 444           b. The request specifies:
  - 446               1. Multipart XML
  - 2. Search parameters, including:
    - 448                   a) Patient ID
    - b) Issuer of Patient ID
    - 450                   c) Patient Name
    - d) Study Description
    - e) Study Date
    - f) Modalities in Study
    - 452                   g) Referring Physician
    - h) etc.
- 454           c. The Response provides
  - 456               1. One PS 3.19 XML NativeDicomModel element for each matching Study
  - 2. All requested DICOM attributes for each matching Study
  - 3. WADO-RS Retrieve URL for each matching Study
- 458           d. The requesting system identifies the Studies of interest and uses WADO-RS to retrieve data

#### 460 **HHH.4.3.2 XML Study, Series and Instance Search Use Case**

- 462           a. The requesting system is a simple web-based application that can make QIDO-RS requests and parse XML and then make WADO URL requests
- 464           b. The request specifies:
  - 466               1. Multipart XML
  - 2. Search parameters, including:
    - 468                   a) Patient ID
    - b) Issuer of Patient ID
    - c) Patient Name
    - d) Patient Date of Birth
    - 470                   e) Study Description
    - f) Study Date
    - 472                   g) Modalities in Study

- h) Referring Physician
- 474 c. The Response provides
  - 1. One PS 3.19 XML NativeDicomModel element for each matching Study
  - 476 2. All requested DICOM attributes for each matching Study
- 478 d. The requesting system identifies the Study of interest and uses Search For Series to identify a series of interest
- e. [repeat b-d for Series, Instance]
- 480 f. The requesting system uses WADO URL to retrieve specific instances

482 **HHH.4.3.3 JSON Use Case**

- 484 a. The requesting system is a mobile application that can make QIDO-RS requests, parse JSON and then make WADO URL requests.
- 486 b. The request specifies:
  - 1. JSON
  - 2. Search parameters, including:
    - 488 a) Patient ID
    - b) Issuer of Patient ID
    - 490 c) Patient Name
    - d) Patient Date of Birth
    - 492 e) Study Description
    - f) Study Date
    - 494 g) Modalities in Study
    - h) Referring Physician
- 496 c. The Response provides
  - 1. One DICOM JSON element containing all matching Studies
  - 498 2. All requested DICOM attributes for each matching Study
- 500 d. The requesting system identifies the Study of interest and uses Search For Series to identify a series of interest
- e. [repeat b-d for Series, Instance]
- 502 f. The requesting system uses WADO URL to retrieve specific instances

504 **Changes to NEMA Standards Publication PS 3.18-2012**

**Digital Imaging and Communications in Medicine (DICOM)**

506 **Part 18: Web Services**

Insert into PS 3.18 Section 3 Normative References (in correct alphabetical order)

508 IETF RFC 4627 The application/json Media Type for JavaScript Object Notation (JSON)

510 Insert into PS 3.18 Section 5 Symbols and abbreviated terms (in correct alphabetical order)

**5 Symbols and abbreviated terms**

512 QIDO-RS Query based on ID for DICOM Objects by RESTful Services

514 Update PS 3.18 Section 6.1 INTERACTION as indicated.

**6 Data Communication Requirements**

516 **6.1 INTERACTION**

The interaction shall be as shown in Figure 6-1.

518 Multiple communications modes are possible:

- URI based mechanism using HTTP Get: WADO-URI Type request
- 520 — Web Services (WS\*) using HTTP Post: WADO-WS, either:
  - 522 a. DICOM Requester (Retrieve Imaging Document Set)
  - b. Rendered Requester (Retrieve Rendered Imaging Document Set)
  - 524 c. Metadata Requester (Retrieve Imaging Document Set Metadata)
- 526 — RESTful Services (RS) using HTTP Get: WADO-RS, either:
  - 528 a. DICOM Requester (Retrieve Study, Series, or Instance DICOM Objects)
  - b. Pixel Data Requester (Retrieve Instance Frame Pixel Data)
  - c. Bulk Data Requester (Retrieve Study, Series, Instance bulk data)
  - 530 d. Metadata Requester (Retrieve Study Metadata)

532 — **RESTful Services (RS) using HTTP Get: QIDO-RS:**  
533 **a. Query Requester (Search for Study, Series or Instance DICOM Objects)**

- 534 — RESTful Services (RS) using HTTP Post: STOW-RS, either:
- 536 a. DICOM Creator (Store Instances)
- 538 b. Metadata and Bulk Data Creator (Store Instances)

|   |
|---|
| <b>Append below PS 3.18 Section 6.6 RS REQUEST/RESPONSE</b> |
|---|

540 **6.7 QIDO-RS REQUEST/RESPONSE**

541 DICOM QIDO-RS defines several action types. An implementation shall support the following action  
542 types:

- 543 a. SearchForStudies
- 544 This action searches for DICOM Studies that match specified search parameters and returns a list of matching studies and the requested attributes for each study.
- 545 b. SearchForSeries
- 546 This action searches for DICOM Series that match specified search parameters and returns a list of matching series and the requested attributes for each series.
- 548 c. SearchForInstances
- 549 This action searches for DICOM Instances that match specified search parameters and returns a list of matching instances and the requested attributes for each instance.
- 550
- 551

552 **6.7.1 QIDO-RS – Search**

553 **6.7.1.1 Request**

The specific resources to be used for the search actions shall be as follows:

- 556 — Resource
- 557 — SearchForStudies
- 558 — {SERVICE}/studies[?query]
- 559 — SearchForSeries
- 560 — {SERVICE}/studies/{StudyInstanceUID}/series[?query]
- 561 — {SERVICE}/series[?query]
- 562 — SearchForInstances
- 563 — {SERVICE}/studies/{StudyInstanceUID}/series/{SeriesInstanceUID}/instances[?query]
- 564 — {SERVICE}/studies/{StudyInstanceUID}/instances[?query]
- 565 — {SERVICE}/instances[?query]
- 566 where
- 567 — {SERVICE} is the base URL for the QIDO RESTful service. This may be a combination of scheme (http or https), host, port, and application.
- 568 — {StudyInstanceUID} is the unique Study Instance UID for a single study.
- 570 — {SeriesInstanceUID} is the unique Series Instance UID for a single series.

571 — Method

- GET
- 574
- Headers
- 576 — Accept – The Media Type of the query results. The types allowed for this request header are:
- multipart/related; type=application/dicom+xml (default)
- 578 Specifies that the results should be DICOM PS3.19 XML (one part per result)
- application/json
- 580 Specifies that the results should be DICOM JSON
- A QIDO-RS provider shall support both Accept header values
- 582 — Cache-control: no-cache (recommended)
- If included, specifies that search results returned should be current and not cached.
- 584
- Query key=value pairs
- 586 — {attributeID}={value}
- 0-n / {attributeID}={value} pairs allowed
- 588 — includefield={attributeID} | all
- 0-n includefield / {attributeID} pairs allowed, where “all” indicates that all available attributes should be included for each response.
- 590
- 592 Each {attributeID} must refer to one of:
- Patient IE attributes
- 594
- Study IE attributes
  - Series IE attributes (SearchForSeries or SearchForInstances requests only)
- 596
- Composite Instance IE attributes (SearchForInstances requests only)
  - Additional Query / Retrieve Attributes (DICOM PS 3.4 C.3.4)
- 598
- Timezone Offset From UTC (0008,0201)
- 600 Each {attributeID} query value must be unique unless the associated DICOM Attribute allows UID List matching (see DICOM PS3.4 C.2.2.2.2), in which case each {value} will be interpreted to be
- 602 an element of the UID List.
- 604 The acceptable values for {value} are determined by the types of matching allowed by C-FIND for its associated {attributeID} (see PS3.4 C.2.2.2). All characters in {value} that are disallowed for
- 606 URLs must be URL encoded. See IETF RFC 1738 for details.
- 608 If an {attributeID} is passed as the value of an “includefield” query key this is equivalent to C-FIND Universal matching for the specified attribute (see DICOM PS3.4 C.2.2.2.3).
- 610
- fuzzymatching=true | false
- 612
- limit={maximumResults}
  - offset={skippedResults}
- 614
- {attributeID} can be one of the following:
- 616 — {dicomTag}

— {dicomKeyword}  
618 — {dicomTag}.{attributeID}, where {attributeID} is an element of the sequence specified by {dicomTag}  
— {dicomKeyword}.{attributeID}, where {attributeID} is an element of the sequence specified  
620 by {dicomKeyword}

622 {dicomTag} is the eight character hexadecimal string corresponding to the Tag of a DICOM Attribute (see PS3.6 Section 6).

624 {dicomKeyword} is the Keyword of a DICOM Attribute (see PS3.6 Section 6).

Note: Examples of valid values for {attributeID}:

626 — 0020000D  
— StudyInstanceUID  
628 — 00101002.00100020  
— OtherPatientIDsSequence.PatientID  
630 — 00101002.00100024.00400032  
— OtherPatientIDsSequence.IssuerOfPatientIDQualifiersSequence.UniversalEntityID  
632

Note: Examples of valid QIDO-RS URLs:

634 — <http://dicomrs/studies?PatientID=11235813>  
— <http://dicomrs/studies?PatientID=11235813&StudyDate=20130509>  
636 — [http://dicomrs/studies?00100010=SMITH\\*&00101002.00100020=11235813&limit=25](http://dicomrs/studies?00100010=SMITH*&00101002.00100020=11235813&limit=25)  
— [http://dicomrs/studies?00100010=SMITH\\*&OtherPatientIDsSequence.00100020=11235813](http://dicomrs/studies?00100010=SMITH*&OtherPatientIDsSequence.00100020=11235813)  
638 — [http://dicomrs/studies?PatientID=11235813&includefield=00081048&includefield=00081049  
&includefield=00081060](http://dicomrs/studies?PatientID=11235813&includefield=00081048&includefield=00081049&includefield=00081060)  
640 — <http://dicomrs/studies?PatientID=11235813&StudyDate=20130509-20130510>  
— [http://dicomrs/studies?StudyInstancrUID=1.2.392.200036.9116.2.2.2.2162893313.1029997326.  
642 94587%2c1.2.392.200036.9116.2.2.2.2162893313.1029997326.94583](http://dicomrs/studies?StudyInstancrUID=1.2.392.200036.9116.2.2.2.2162893313.1029997326.94587%2c1.2.392.200036.9116.2.2.2.2162893313.1029997326.94583)

#### 644 **6.7.1.2 Response**

The Server shall perform the query indicated in the request. The Server shall return the query results or,  
646 when the query cannot be performed, an error code.

If the limit query key is not specified or its value exceeds the total number of matching results then  
648 {maximumResults} is the lesser of the number of matching results and the maximum number of results supported by the Server.

650 If the offset query key is not specified or its value is less than zero then {skippedResults} is zero.

The first result returned shall be result number ({skippedResults} + 1). The last result returned shall be  
652 result number ({skippedResults} + {maximumResults}). If ({skippedResults} + 1) exceeds {maximumResults} then no results are returned.

654 If the number of results exceeds the maximum supported by the server, the server shall return the maximum supported results and the response shall include the following HTTP/1.1 Warning header (see  
656 RFC 2616 Section 14.46):

658 Warning: 299 {SERVICE}: "The number of results exceeded the maximum supported by the server. Additional results can be requested."

660 Note: The client can request additional results by specifying a value for the "offset" query key.

662 The server shall be idempotent so that if the list of results is the same, the response to a request with a specific set of parameters shall always be the same, including order. If the complete list of results is different for subsequent transactions the responses may be different. In a situation where results are changing due to changes in the server contents, queries using the limit and offset may be inconsistent.

666 The response format depends on the Accept header specified in the request.

#### 6.7.1.2.1 Matching

668 The matching semantics for each attribute are determined by the types of matching allowed by C-FIND (see PS3.4 C.2.2.2).

670 Matching results shall be generated according to the Hierarchical Search Method described in PS 3.4 C.4.1.3.1.1.

672 Combined Datetime matching shall be performed (see DICOM PS3.4 C.2.2.2.5).

674 Note: If a QIDO-RS provider is acting as a proxy for a C-FIND SCP that does not support combined Datetime matching the QIDO-RS provider will need to perform a C-FIND request using Date only and filter results outside the time range before returning a QIDO-RS response

676

678 If the TimezoneOffsetFromUTC / 00080201 query key is included in the request, dates and times in the request are to be interpreted in the specified time zone.

680 If the "fuzzymatching=true" query key/value is included in the request and it is supported then additional fuzzy semantic matching of person names shall be performed in the manner specified in the DICOM Conformance Statement for the service provider.

682 If the "fuzzymatching=true" query key/value is included in the request and it is not supported, the response shall include the following HTTP/1.1 Warning header (see RFC 2616 Section 14.46):

684 Warning: 299 {SERVICE}: "The fuzzymatching parameter is not supported. Only literal matching has been performed."

686

688 where {SERVICE} is the base URL for the QIDO-RS provider. This may be a combination of scheme (http or https), host, port, and application.

690 Note: The Warning header is separate from the Status Line and does not affect the returned Status Code.

#### 6.7.1.2.1.1 Study Matching

692 Providers of the SearchForStudies service shall support the search query keys described in Table 6.7.1-1:

694 **Table 6.7.1-1  
QIDO-RS STUDY Search Query Keys**

| Key Word        | Tag      |
|-----------------|----------|
| StudyDate       | 00080020 |
| StudyTime       | 00080030 |
| AccessionNumber | 00080050 |



|                        |          |
|------------------------|----------|
| ModalitiesInStudy      | 00080061 |
| ReferringPhysicianName | 00080090 |
| PatientName            | 00100010 |
| PatientID              | 00100020 |
| StudyInstanceUID       | 0020000D |
| StudyID                | 00200010 |

696 **6.7.1.2.1.2 Series Matching**

Providers of the SearchForSeries service shall support the search query keys described in Table 6.7.1-1a:

698

**Table 6.7.1-1a  
 QIDO-RS SERIES Search Query Keys**

| Key Word                        | Tag      |
|---------------------------------|----------|
| Modality                        | 00080060 |
| SeriesInstanceUID               | 0020000E |
| SeriesNumber                    | 00200011 |
| PerformedProcedureStepStartDate | 00400244 |
| PerformedProcedureStepStartTime | 00400245 |
| RequestAttributeSequence        | 00400275 |
| >ScheduledProcedureStepID       | 00400009 |
| >RequestedProcedureID           | 00401001 |

700

If {StudyInstanceUID} is not specified in the URL and this form of Relational Query is supported, all Study-level attributes specified in Table 6.7.1-1 shall also be supported.

702

**6.7.1.2.1.3 Instance Matching**

704 Providers of the SearchForInstances service shall support the search query keys described in Table 6.7.1-1c:

706

**Table 6.7.1-1b  
 QIDO-RS INSTANCE Search Query Keys**

| Key Word       | Tag      |
|----------------|----------|
| SOPClassUID    | 00080016 |
| SOPInstanceUID | 00080018 |
| InstanceNumber | 00200013 |

708

If {StudyInstanceUID} is not specified in the URL and this form of Relational Query is supported, all Study-level attributes specified in Table 6.7.1-1 shall also be supported.

710

If {SeriesInstanceUID} is not specified in the URL and this form of Relational Query is supported, all Series-level attributes specified in Table 6.7.1-1a shall also be supported.

712

**6.7.1.2.2 Query Result Attributes**

714 **6.7.1.2.2.1 Study Result Attributes**

For each matching Study, the QIDO-RS provider shall return all attributes in accordance with Table 6.7.1-2:  
716 2:

718 **Table 6.7.1-2  
QIDO-RS STUDY Returned Attributes**

| Attribute Name  | Tag         | Notes  |
|---|-------------|--|
| Specific Character Set  | (0008,0005) | If necessary for encoding any returned attributes              |
| Study Date  | (0008,0020) |  |
| Study Time  | (0008,0030) |  |
| Accession Number  | (0008,0050) |  |
| Instance Availability   | (0008,0056) |  |
| Modalities in Study   | (0008,0061) |  |
| Referring Physician's Name  | (0008,0090) |  |
| Timezone Offset From UTC  | (0008,0201) | May be absent if no value is available                         |
| Retrieve URL  | (0008,1190) | Shall be empty if the resource cannot be retrieved via WADO-RS |
| Patient's Name  | (0010,0010) |  |
| Patient ID  | (0010,0020) |  |
| Patient's Birth Date  | (0010,0030) |  |
| Patient's Sex   | (0010,0040) |  |
| Study Instance UID  | (0020,000D) |  |
| Study ID  | (0020,0010) |  |
| Number of Study Related Series  | (0020,1206) |  |
| Number of Study Related Instances   | (0020,1208) |  |
| All other Study Level DICOM Attributes passed as {attributeID} query keys that are supported by the service provider as matching or return attributes |             |  |
| All other Study Level DICOM Attributes passed as "includefield" query values that are supported by the service provider as return attributes          |             |  |
| All available Study Level DICOM Attributes if the "includefield" query key is included with a value of "all"  |             |  |

720 Series Level and Instance Level attributes passed as "includefield" query values shall not be returned.

Note: The above list is consistent with those required for IHE RAD-14 (see  
722 [http://www.ihe.net/Technical\\_Framework/upload/IHE\\_RAD\\_TF\\_Vol2.pdf](http://www.ihe.net/Technical_Framework/upload/IHE_RAD_TF_Vol2.pdf) Table 4.14-1).

724 **6.7.1.2.2.2 Series Result Attributes**

For each matching Series, the QIDO-RS provider shall return all attributes listed in Table 6.7.1-2a:

726 **Table 6.7.1-2a  
QIDO-RS SERIES Returned Attributes**

| Attribute Name   | Tag         | Notes  |
|--|-------------|--|
| Specific Character Set   | (0008,0005) | If necessary for encoding any returned attributes              |
| Modality   | (0008,0056) |  |
| Timezone Offset From UTC   | (0008,0201) | May be absent if no value is available                         |
| Series Description   | (0008,103E) | May be absent if no value is available                         |
| Retrieve URL   | (0008,1190) | Shall be empty if the resource cannot be retrieved via WADO-RS |
| Series Instance UID  | (0020,000E) |  |
| Series Number  | (0020,0011) |  |
| Number of Series Related Instances   | (0020,1209) |  |
| Performed Procedure Step Start Date  | (0040,0244) | May be absent if no value is available                         |
| Performed Procedure Step Start Time  | (0040,0245) | May be absent if no value is available                         |
| Request Attribute Sequence   | (0040,0275) | May be absent if no value is available                         |
| >Scheduled Procedure Step ID   | (0040,0009) |  |
| >Requested Procedure ID  | (0040,1001) |  |
| All other Series Level DICOM Attributes passed as {attributeID} query keys that are supported by the service provider as matching or return attributes |             |  |
| All other Study or Series Level DICOM Attributes passed as "includefield" query values that are supported by the service provider as return attributes |             |  |
| All available Instance Level DICOM Attributes if the "includefield" query key is included with a value of "all"  |             |  |
| If {StudyInstanceUID} is not specified, all Study-level attributes specified in Table 6.7.1-2  |             |  |

728

Instance Level attributes passed as "includefield" query values shall not be returned.

730 Note: The above list is consistent with the attributes required for IHE RAD-14 (see  
[http://www.ihe.net/Technical\\_Framework/upload/IHE\\_RAD\\_TF\\_Vol2.pdf](http://www.ihe.net/Technical_Framework/upload/IHE_RAD_TF_Vol2.pdf) Table 4.14-1).

732

**6.7.1.2.2.3 Instance Result Attributes**

734 For each matching instance, the QIDO-RS provider shall return all attributes listed in Table 6.7.1-2b:

**Table 6.7.1-2b  
QIDO-RS INSTANCE Returned Attributes**

736

| Attribute Name           | Tag         | Notes  |
|--------------------------|-------------|--|
| Specific Character Set   | (0008,0005) | If necessary for encoding any returned attributes              |
| SOP Class UID            | (0008,0016) |  |
| SOP Instance UID         | (0008,0018) |  |
| Instance Availability    | (0008,0056) |  |
| Timezone Offset From UTC | (0008,0201) | May be absent if no value is available                         |
| Retrieve URL             | (0008,1190) | Shall be empty if the resource cannot be retrieved via WADO-RS |

|  |             |  |
|--|-------------|--|
| Instance Number  | (0020,0013) |  |
| Rows   | (0028,0010) | Only present for Image Instances             |
| Columns  | (0028,0011) | Only present for Image Instances             |
| Bits Allocated   | (0028,0100) | Only present for Image Instances             |
| Number of Frames   | (0028,0008) | Only present for Multi-frame image instances |
| All other Instance Level DICOM Attributes passed as {attributeID} query keys that are supported by the service provider as matching or return attributes         |             |  |
| All other Study, Series or Instance Level DICOM Attributes passed as "includefield" query values that are supported by the service provider as return attributes |             |  |
| All available Instance Level DICOM Attributes if the "includefield" query key is included with a value of "all"  |             |  |
| If {StudyInstanceUID} is not specified, all Study-level attributes specified in Table 6.7.1-2  |             |  |
| If {SeriesInstanceUID} is not specified, all Series-level attributes specified in Table 6.7.1-2a   |             |  |

738 Note: The above list is consistent with the attributes required for IHE RAD-14 (see  
740 [http://www.ihe.net/Technical\\_Framework/upload/IHE\\_RAD\\_TF\\_Vol2.pdf](http://www.ihe.net/Technical_Framework/upload/IHE_RAD_TF_Vol2.pdf) Tables 4.14-1 and 4.14-2).

#### 740 6.7.1.2.3 Query Result Messages

742 The server shall support returning query results as:

- XML Results
- 744 — JSON Results

746 The result format used shall depend on the Accept header of the request.

#### 748 6.7.1.2.3.1 XML Results

- Content-Type: multipart/related; type=application/dicom+xml
- 750 — The response is a multipart message body where each part is a DICOM PS 3.19 XML NativeDicomModel element containing the attributes for one matching Study, Series or Instance (see DICOM PS 3.19 Annex A.1).
- 752 — The provider of the QIDO service may use a BulkData reference at its discretion (see DICOM PS 754 3.19 Table A.1.5-2 and 6.5.6). For example, this might be done to avoid encoding a large DICOM Value Field, such as an image thumbnail.
- 756 — If there are no matching results, the message body will be empty.

758 — Each item in the multipart response will contain the following HTTP/1.1 headers:

- Content-Type: application/dicom+xml

760

#### 6.7.1.2.3.2 JSON Results

762 — Content-Type: application/json

- The response is a DICOM JSON message containing a DICOM JSON property for each matching  
764 study, series or instance containing sub-properties describing the matching attributes for each study, series or instance (see F.2).

- 766 — The provider of the QIDO service may use a BulkDataURI reference at its discretion (see F.2.6).  
768 For example, this might be done to avoid encoding a large DICOM Value Field, such as an image thumbnail.
- 770 — If there are no matching results, the JSON message is empty.

**6.7.1.3 Status Codes**

772 Table 6.7-1 lists the HTTP/1.1 status codes that shall be used to report any of the associated error and warning situations. Other error codes may be present for other error and warning situations.

774

**Table 6.7-1  
QIDO-RS HTTP/1.1 STATUS CODES**

| Code    | Name                     | Description  |
|---------|--------------------------|--|
| Success |                          |  |
| 200     | OK                       | The query completed and any matching results are returned in the message body.   |
| Failure |                          |  |
| 400     | Bad Request              | The QIDO-RS Provider was unable to perform the query because the Service Provider cannot understand the query component.                                   |
| 401     | Unauthorized             | The QIDO-RS Provider refused to perform the query because the client is not authenticated.   |
| 403     | Forbidden                | The QIDO-RS Provider understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).               |
| 413     | Request entity too large | The query was too broad and a narrower query or paging should be requested. The use of this status code should be documented in the conformance statement. |
| 503     | Busy                     | Service is unavailable.  |

776

**Append PS 3.18 by the following annex.**

778

**Annex F DICOM JSON Model**

**F.1 INTRODUCTION TO JAVASCRIPT OBJECT NOTATION (JSON)**

780 JSON is a text-based open standard, derived from JavaScript, for representing data structures and associated arrays. It is language-independent, and primarily used for serializing and transmitting

782 lightweight structured data over a network connection. It is described in detail by the Internet Engineering Task Force (IETF) in RFC 4627, available at <http://www.ietf.org/rfc/rfc4627.txt>.

784 The DICOM JSON Model complements the XML-based Native DICOM Model, by providing a lightweight representation of data returned by DICOM web services. While this representation can be used to encode any type of DICOM Data Set it is expected to be used by client applications, especially mobile clients, such as described in the QIDO-RS use cases (see PS 3.17 Annex HHH).

## 788 **F.2 DICOM JSON MODEL**

The DICOM JSON Model follows the Native DICOM Model for XML very closely, so that systems can take advantage of both formats without much retooling. The Media Type for DICOM JSON is application/json. The default character repertoire shall be UTF-8 / ISO\_IR 192.

### 792 **F.2.1 Multiple Results Structure**

Multiple results returned in JSON are organized as a single top-level array of JSON objects. This differs from the Native DICOM Model, which returns multiple results as a multi-part collection of singular XML documents.

#### 796 **F.2.1.1 Examples**

##### **F.2.1.1.1 Native DICOM Model**

```
798 <?xml version="1.0" encoding="UTF-8" xml:space="preserve" ?>
    <NativeDicomModel>
800     <DicomAttribute tag="0020000D" vr="UI" keyword="StudyInstanceUID">
        <Value
802 number="1">1.2.392.200036.9116.2.2.2.1762893313.1029997326.945873</Value>
        </DicomAttribute>
804 </NativeDicomModel>
...
806 <?xml version="1.0" encoding="UTF-8" xml:space="preserve" ?>
    <NativeDicomModel>
808     <DicomAttribute tag="0020000D" vr="UI" keyword="StudyInstanceUID">
        <Value
810 number="1">1.2.444.200036.9116.2.2.2.1762893313.1029997326.945876</Value>
        </DicomAttribute>
812 </NativeDicomModel>
```

##### 814 **F.2.1.1.2 DICOM JSON Model**

```
[
816   {
      "0020000D": {
818       "vr": "UI",
       "Value": [ "1.2.392.200036.9116.2.2.2.1762893313.1029997326.945873" ]
820     }
   }
822   {
      "0020000D" : {
824       "vr": "UI",
       "Value": [ "1.2.392.200036.9116.2.2.2.2162893313.1029997326.945876" ]
826     }
   }
828 ]
```

830 **F.2.2 DICOM JSON Model Object Structure**

The DICOM JSON Model object is a representation of a DICOM Data Set.

832 The internal structure of the DICOM JSON Model object is a sequence of objects representing attributes within the DICOM Data Set.

834 Attribute objects within a DICOM JSON Model object must be ordered by their property name in ascending order.

836 Group Length (gggg,0000) attributes shall not be included in a DICOM JSON Model object.

The name of each attribute object is:

838 — The eight character uppercase hexadecimal representation of a DICOM Tag

840 Each attribute object contains the following named child objects:

— vr: A string encoding the DICOM Value Representation. The mapping between  
842 DICOM Value Representations and JSON Value Representations is described in F.2.3

844 — At most one of:

— Value: An array containing one of:

846 — The Value Field elements of a DICOM attribute with a VR other than PN, SQ, OB, OD, OF, OW, or UN (described in F.2.4)

848 The encoding of empty Value Field elements is described in F.2.5

— The Value Field elements of a DICOM attribute with a VR of PN. The non-empty name components of each element are encoded as a JSON strings with the following names:

850 — Alphabetic

852 — Ideographic

— Phonetic

854 — JSON DICOM Model objects corresponding to the sequence items of an attribute with a VR of SQ

856 Empty sequence items are represented by empty objects

— BulkDataURI: A string encoding the WADO-RS URL of a bulk data item describing the Value Field of an enclosing Attribute with a VR of FL, FD, IS, LT, OB, OD, OF, OW, SL, SS, ST, UL, UN, US, or UT (described in F.2.6)

860 — InlineBinary: A base64 string encoding the Value Field of an enclosing Attribute with a VR of OB, OD, OF, OW, or UN (described in F.2.7)

862

Note: 1. For Private Data Elements, the group and element numbers will follow the rules specified in PS 3.5 Section 7.8.1

864

2. The person name representation is more closely aligned with the DICOM Data Element representation than the DICOM PS 3.19 XML representation.

866

868 **F.2.3 DICOM JSON Value Representation**

The value representation (VR) is included in each DICOM JSON Model attribute object and named "vr".

870 For example:

"vr": "CS"

872

All DICOM Value Representations are mapped to specified JSON Data Types (see Table F.2.3-1). The JSON encodings shall conform to the Definition, Character Repertoire (if applicable) and Length of Value specified for that Value Representation (see PS 3.5 Section 6.2) with the following exceptions:

874

876 — Attributes with a Value Representation of AT shall be restricted to eight character uppercase hexadecimal representation of a DICOM Tag

878

**Table F.2.3-1  
DICOM VR to JSON Data Type Mapping**

880

| VR Name | Type                  | JSON Data Type   |
|---------|-----------------------|--|
| AE      | Application Entity    | <i>String</i>  |
| AS      | Age String            | <i>String</i>  |
| AT      | Attribute Tag         | <i>String</i>  |
| CS      | Code String           | <i>String</i>  |
| DA      | Date                  | <i>String</i>  |
| DS      | Decimal               | <i>Number</i>  |
| DT      | Date Time             | <i>String</i>  |
| FL      | Floating Point Single | <i>Number</i>  |
| FD      | Floating Point Double | <i>Number</i>  |
| IS      | Integer String        | <i>Number</i>  |
| LO      | Long String           | <i>String</i>  |
| LT      | Long Text             | <i>String</i>  |
| OB      | Other Byte String     | <i>Base64 encoded string</i>   |
| OD      | Other Double String   | <i>Base64 encoded string</i>   |
| OF      | Other Float String    | <i>Base64 encoded string</i>   |
| OW      | Other Word String     | <i>Base64 encoded string</i>   |
| PN      | Person Name           | <i>Object containing Person Name component groups as strings (see F.2.2)</i> |
| SH      | Short String          | <i>String</i>  |
| SL      | Signed Long           | <i>Number</i>  |



|    |                |  |
|----|----------------|--|
| SQ | Sequence       | <i>Array containing DICOM JSON Objects</i> |
| SS | Signed Short   | <i>Number</i>                              |
| ST | Short Text     | <i>String</i>                              |
| TM | Time           | <i>String</i>                              |
| UI | UID            | <i>String</i>                              |
| UL | Unsigned Long  | <i>Number</i>                              |
| UN | Unknown        | <i>Base64 encoded string</i>               |
| US | Unsigned Short | <i>Number</i>                              |
| UT | Unlimited Text | <i>String</i>                              |

882 Although data, such as dates, are represented in the DICOM JSON model as strings, it is expected that they will be treated in the same manner as the original attribute as defined by DICOM PS 3.6 section 6.

884 **F.2.4 DICOM JSON Value Multiplicity**

The value or values of a given DICOM attribute are given in the “Value” array. The value multiplicity (VM) is not contained in the DICOM JSON object.

For example:

888 "Value": [ "bar", "foo" ]

890 or:

"Value": [ "bar" ]

892

**F.2.5 DICOM JSON Model Null Values**

894 If an attribute is present in DICOM but empty (i.e. Value Length is 0), it shall be preserved in the DICOM JSON attribute object containing no “Value”, “BulkDataURI” or “InlineBinary”.

896 If a multi-valued attribute has one or more empty values these are represented as “null” array elements. For example:

898 "Value": [ "bar", null , "foo" ]

900 If a sequence contains empty items these are represented as empty JSON object in the array.

"Value": [ { ... }, { }, { ... } ]

902

**F.2.6 BulkDataURI**

904 If an attribute contains a “BulkDataURI”, this contains the URI of a bulk data element as defined in DICOM PS 3.19 Table A.1.5-2.

906 **F.2.7 InlineBinary**

If an attribute contains an “InlineBinary”, this contains the base64 encoding of the enclosing attribute’s Value Field.

910 There is a single InlineBinary value representing the entire Value Field, and not one per Value in the case  
911 where the Value Multiplicity is greater than one. E.g., a LUT with 4096 16 bit entries that may be encoded  
912 in DICOM with a Value Representation of OW, with a VL of 8192 and a VM of 1, or a US VR with a VL of  
913 8192 and a VM of 4096 would both be represented as a single InlineBinary string.

All rules (e.g. byte ordering and swapping) in DICOM PS 3.5 apply.

914 Note: Implementers should in particular pay attention the PS 3.5 rules regarding the value representations of  
915 OD, OF and OW.

916

### **F.3 TRANSFORMATION WITH OTHER DICOM FORMATS**

#### **918 F.3.1 Native DICOM Model XML**

919 The transformation between the Native DICOM Model XML and the DICOM JSON model cannot be done  
920 through the use of generic XML - JSON converters.

The mapping between the two formats is as follows (see also Table F.3.1-1):

- 922 — The XML “NativeDicomModel” element maps to the DICOM JSON Model Object
- 924 — Each “DicomAttribute” element maps to an attribute object within the DICOM JSON model object
  - The “tag” attribute maps to the JSON object name
  - 926 — The Native DICOM Model XML allows for duplicate Tag values and the DICOM JSON model  
927 does not. To resolve this, private attribute Tag values must be remapped according to the  
928 conflict avoidance rules specified in PS 3.5 Section 7.8.1.
  - The “vr” attribute maps to the “vr” child string
- 930 — “Value” elements map to members of the “Value” child array
  - 932 — A “Value” element with the attribute “number=n” maps to “Value[n-1]”
  - Empty “Value” elements are represented by “null” entries in the “Value” array
- 934 — “PersonName” elements map to objects within the “Value” array. For a “PersonName” element with the  
935 attribute “number=n”:
  - 936 — The “Alphabetic” element maps to “Value[n-1].Alphabetic”
  - 937 — The “Ideographic” element maps to “PersonName[n].Ideographic”
  - 938 — The “Phonetic” element maps to “PersonName[n].Phonetic”
- 940 — “Item” elements map to members of the “Value” child array
  - 942 — An “Item” element with the attribute “number=n” maps to “Value[n-1]”
  - Empty “Item” elements are represented by empty JSON property entries in the “Value” array
- 944 — The “uri” attribute of the “BulkData” element maps to the “BulkDataURI” string
- 946 — The “InlineBinary” element maps to the “InlineBinary” string
- 948

950

**Table F.3.1-1  
XML to JSON Mapping**

| DICOM PS 3.19 XML   | DICOM JSON Model   |
|---|--|
| <pre>&lt;NativeDicomModel&gt;   &lt;DicomAttribute tag=ggggee01 ... /&gt;   &lt;DicomAttribute tag=ggggee02 ... /&gt;   ... &lt;/NativeDicomModel&gt;</pre>   | <pre>{   ggggee01: { ... },   ggggee02: { ... },   ... }</pre>   |
| <pre>&lt;DicomAttribute   tag=ggggeeee   vr=VR &gt;   &lt;Value number="1"&gt;Value&lt;/Value&gt; &lt;/DicomAttribute&gt;</pre>   | <pre>ggggeeee: {   "vr": VR,   "Value": [ Value ] }</pre>  |
| <pre>&lt;DicomAttribute tag=ggggeeee ... &gt;   &lt;Value number="1"&gt;Value1&lt;/Value&gt;   &lt;Value number="2"&gt;Value2&lt;/Value&gt;   ... &lt;/DicomAttribute&gt;</pre>   | <pre>ggggeeee: {   ...   "Value": [ Value1,              Value2, ...             ] }</pre>   |
| <pre>&lt;DicomAttribute tag=ggggeeee... &gt; &lt;/DicomAttribute&gt;</pre>  | <pre>ggggeeee: {   ... }</pre>   |
| <pre>&lt;DicomAttribute tag=ggggeeee vr="PN" ... &gt;   &lt;PersonName number="1"&gt;     &lt;Alphabetic&gt;       &lt;FamilyName&gt;SB1     &lt;/FamilyName&gt;       &lt;GivenName&gt;SB2     &lt;/GivenName&gt;       &lt;MiddleName&gt;SB3     &lt;/MiddleName&gt;       &lt;NamePrefix&gt;SB4     &lt;/NamePrefix&gt;       &lt;NameSuffix&gt;SB5     &lt;/NameSuffix&gt;     &lt;/Alphabetic&gt;     &lt;Ideographic&gt;       &lt;FamilyName&gt;ID1     &lt;/FamilyName&gt;     ...     &lt;/Ideographic&gt;     &lt;Phonetic&gt;       &lt;FamilyName&gt;PH1     &lt;/FamilyName&gt;     ...     &lt;/Phonetic&gt;   &lt;/PersonName&gt;   &lt;PersonName number="2"&gt;     &lt;Alphabetic&gt;       &lt;FamilyName&gt;SB6     &lt;/FamilyName&gt;     &lt;/Alphabetic&gt;   &lt;/PersonName&gt; &lt;/DicomAttribute&gt;</pre> | <pre>ggggeeee: {   ...   "vr": "PN",   "Value": [     {       "Alphabetic":         "SB1^SB2^SB3^SB4^SB5",       "Ideographic":         "ID1^ID2^ID3^ID4^ID5",       "Phonetic":         "PH1^PH2^PH3^PH4^PH5"     } ,     {       "Alphabetic":         "SB6"     }   ] }</pre> |
| <pre>&lt;DicomAttribute tag=ggggeeee vr="SQ" ... &gt;</pre>   | <pre>ggggeeee: {</pre>   |

|  |   |
|--|---|
| <pre> &lt;Item number="1"&gt;   &lt;DicomAttribute tag=<b>ggggee01</b> ... /&gt;   &lt;DicomAttribute tag=<b>ggggee02</b> ... /&gt;   ... &lt;/Item&gt; &lt;Item number="2"&gt;   &lt;DicomAttribute tag=<b>ggggee01</b> ... /&gt;   &lt;DicomAttribute tag=<b>ggggee02</b> ... /&gt;   ... &lt;/Item&gt; &lt;Item number="3"&gt; &lt;/Item&gt; ... &lt;/DicomAttribute&gt; </pre> | <pre> ... "vr": "SQ", "Value": [   {     <b>ggggee01</b>: { ... },     <b>ggggee02</b>: { ... },     ...   }   {     <b>ggggee01</b>: { ... },     <b>ggggee02</b>: { ... },     ...   }   { }   ... ] } </pre> |
| <pre> &lt;DicomAttribute tag=<b>ggggeeee</b> ... &gt;   &lt;BulkData URI=<b>BulkDataURI</b>&gt; &lt;/DicomAttribute&gt; </pre>   | <pre> <b>ggggeeee</b>: { ... "BulkDataURI": <b>BulkDataURI</b> } </pre>   |
| <pre> &lt;DicomAttribute tag=<b>ggggeeee</b> ... &gt;   &lt;InlineBinary&gt;<b>Base64String</b>&lt;/InlineBinary&gt; &lt;/DicomAttribute&gt; </pre>  | <pre> <b>ggggeeee</b>: { ... "InlineBinary": <b>"Base64String"</b> } </pre>   |
| <pre> &lt;DicomAttribute tag=<b>gggg00ee</b> PrivateCreator=<b>PrivateCreator</b> ... &gt; ... &lt;/DicomAttribute&gt; </pre>  | <pre> <b>ggggXXee</b>: { ... } </pre>   |

952

#### F.4 DICOM JSON MODEL EXAMPLE

954 // The following example is a QIDO-RS SearchForStudies response consisting  
 // of two matching studies, corresponding to the example QIDO-RS request:  
 956 // GET http://qido.nema.org/studies?PatientID=12345&includefield=all&limit=2

```

[
  958   { // Result 1
    "00080005": {
      960       "vr": "CS",
        "Value": [ "ISO_IR192" ]
      962     },
    "00080020": {
      964       "vr": "DT",
        "Value": [ "20130409" ]
      966     },
    "00080030": {
      968       "vr": "TM",
        "Value": [ "131600.0000" ]
      970     },
    "00080050": {
      972       "vr": "SH",

```

```
          "Value": [ "11235813" ]
974      },
          "00080056": {
976          "vr": "CS",
          "Value": [ "ONLINE" ]
978      },
          "00080061": {
980          "vr": "CS",
          "Value": [
982              "CT",
              "PET"
984          ]
      },
          "00080090": {
986          "vr": "PN",
          "Value": [
988              {
990                  "Alphabetic": "^Bob^Dr."
992              }
      ],
          "00081190": {
994          "vr": "UT",
          "Value": [
996          "http://wado.nema.org/studies/1.2.392.200036.9116.2.2.2.1762893313.1029997326.
998 945873" ]
      },
          "00090010": {
1000          "vr": "LO",
          "Value": [ "Vendor A" ]
1002      },
          "00091002": {
1004          "vr": "UN",
          "Value": [ "z0x9c8v7" ]
1006      },
          "00100010": {
1008          "vr": "PN",
          "Value": [
1010              {
1012                  "Alphabetic": "Wang^XiaoDong",
                  "Ideographic": "王^小東"
1014              }
      ],
          "00100020": {
1016          "vr": "LO",
          "Value": [ "12345" ]
1018      },
          "00100021": {
1020          "vr": "LO",
          "Value": [ "Hospital A" ]
1022      },
          "00100030": {
1024          "vr": "DT",
1026
```

```
    "Value": [ "19670701" ]
1028  },
    "00100040": {
1030    "vr": "CS",
        "Value": [ "M" ]
1032  },
    "00101002": {
1034    "vr": "SQ",
        "Value": [
1036      {
1038        "00100020": {
            "vr": "LO",
            "Value": [ "54321" ]
1040        },
        "00100021": {
1042          "vr": "LO",
            "Value": [ "Hospital B" ]
1044        }
        },
1046      {
1048        "00100020": {
            "vr": "LO",
            "Value": [ "24680" ]
1050        },
        "00100021": {
1052          "vr": "LO",
            "Value": [ "Hospital C" ]
1054        }
        }
1056    ]
    },
    "0020000D": {
1058      "vr": "UI",
        "Value": [
1060 "1.2.392.200036.9116.2.2.2.1762893313.1029997326.945873" ]
1062    },
    "00200010": {
1064      "vr": "SH",
        "Value": [ "11235813" ]
1066    },
    "00201206": {
1068      "vr": "IS",
        "Value": [ 4 ]
1070    },
    "00201208": {
1072      "vr": "IS",
        "Value": [ 942 ]
1074    }
  },
1076  { // Result 2
    "00080005": {
1078      "vr": "CS",
        "Value": [ "ISO_IR192" ]
1080    },
  },
```

```
1082     "00080020": {
1083         "vr": "DT",
1084         "Value": [ "20130309" ]
1085     },
1086     "00080030": {
1087         "vr": "TM",
1088         "Value": [ "111900.0000" ]
1089     },
1090     "00080050": {
1091         "vr": "SH",
1092         "Value": [ "11235821" ]
1093     },
1094     "00080056": {
1095         "vr": "CS",
1096         "Value": [ "ONLINE" ]
1097     },
1098     "00080061": {
1099         "vr": "CS",
1100         "Value": [
1101             "CT",
1102             "PET"
1103         ]
1104     },
1105     "00080090": {
1106         "vr": "PN",
1107         "Value": [
1108             {
1109                 "Alphabetic": "^Bob^^Dr."
1110             }
1111         ]
1112     },
1113     "00081190": {
1114         "vr": "UT",
1115         "Value": [
1116     "http://wado.nema.org/studies/1.2.392.200036.9116.2.2.2.2162893313.1029997326.
1117     945876"
1118         ]
1119     },
1120     "00090010": {
1121         "vr": "LO",
1122         "Value": [ "Vendor A" ]
1123     },
1124     "00091002": {
1125         "vr": "UN",
1126         "Value": [ "z0x9c8v7" ]
1127     },
1128     "00100010": {
1129         "vr": "PN",
1130         "Value": [
1131             {
1132                 "Alphabetic": "Wang^XiaoDong",
1133                 "Ideographic": "王^小東"
1134             }
1135         ]
1136     },
1137     },
```

```
1136     "00100020": {
1138         "vr": "LO",
1140         "Value": [ "12345" ]
1142     },
1144     "00100021": {
1146         "vr": "LO",
1148         "Value": [ "Hospital A" ]
1150     },
1152     "00100030": {
1154         "vr": "DT",
1156         "Value": [ "19670701" ]
1158     },
1160     "00100040": {
1162         "vr": "CS",
1164         "Value": [ "M" ]
1166     },
1168     "00101002": {
1170         "vr": "SQ",
1172         "Value": [
1174             {
1176                 "00100020": {
1178                     "vr": "LO",
1180                     "Value": [ "54321" ]
1182                 },
1184                 "00100021": {
1186                     "vr": "LO",
1188                     "Value": [ "Hospital B" ]
1190                 }
1192             },
1194             {
1196                 "00100020": {
1198                     "vr": "LO",
1200                     "Value": [ "24680" ]
1202                 },
1204                 "00100021": {
1206                     "vr": "LO",
1208                     "Value": [ "Hospital C" ]
1210                 }
1212             }
1214         ]
1216     },
1218     "0020000D": {
1220         "vr": "UI",
1222         "Value": [
1224             "1.2.392.200036.9116.2.2.2.2162893313.1029997326.945876" ]
1226     },
1228     "00200010": {
1230         "vr": "SH",
1232         "Value": [ "11235821" ]
1234     },
1236     "00201206": {
1238         "vr": "IS",
1240         "Value": [ 5 ]
1242     },
1244     },
```



```
1190     "00201208": {  
1191         "vr": "IS",  
1192         "Value": [ 1123 ]  
1193     }  
1194 ]
```

## 1196 F.5 REFERENCES

- 1197 IETF RFC 4627. <http://www.ietf.org/rfc/rfc4627.txt> (Normative JSON definition)
- 1198 JSON. <http://www.json.org/> (Informative)
- 1199 Wikipedia, definition of JSON. <http://en.wikipedia.org/wiki/JSON> (Informative)
- 1200 JSON in FHIR. <http://www.hl7.org/implement/standards/fhir/formats.htm#json>  
(Informative)

## 1202 Changes to NEMA Standards Publication PS 3.19-2011

### 1204 Digital Imaging and Communications in Medicine (DICOM) Part 19: Application Hosting

**Update PS 3.19 A.1.1 Usage as shown below.**

#### 1206 A.1.1 Usage

1207 The Native DICOM Model defines a representation of binary-encoded DICOM SOP Instances as XML  
1208 Infosets that allows a recipient of data to navigate through a binary DICOM data set using XML-based  
tools instead of relying on toolkits that understand the binary encoding of DICOM.

1210 Note: It is not the intention that this form be utilized as the basis for other uses. This form does not take  
1212 advantage of the self-validation features that could be possible with a pure XML representation of the  
data.

1214 With the exception of padding, a data source that is creating a new instance of a native DICOM Model  
(e.g. the result from some analysis application) shall follow the DICOM encoding rules (e.g. the handling of  
1216 character sets) in creating Values for the DicomAttributes within the instance of the Native DICOM Model.

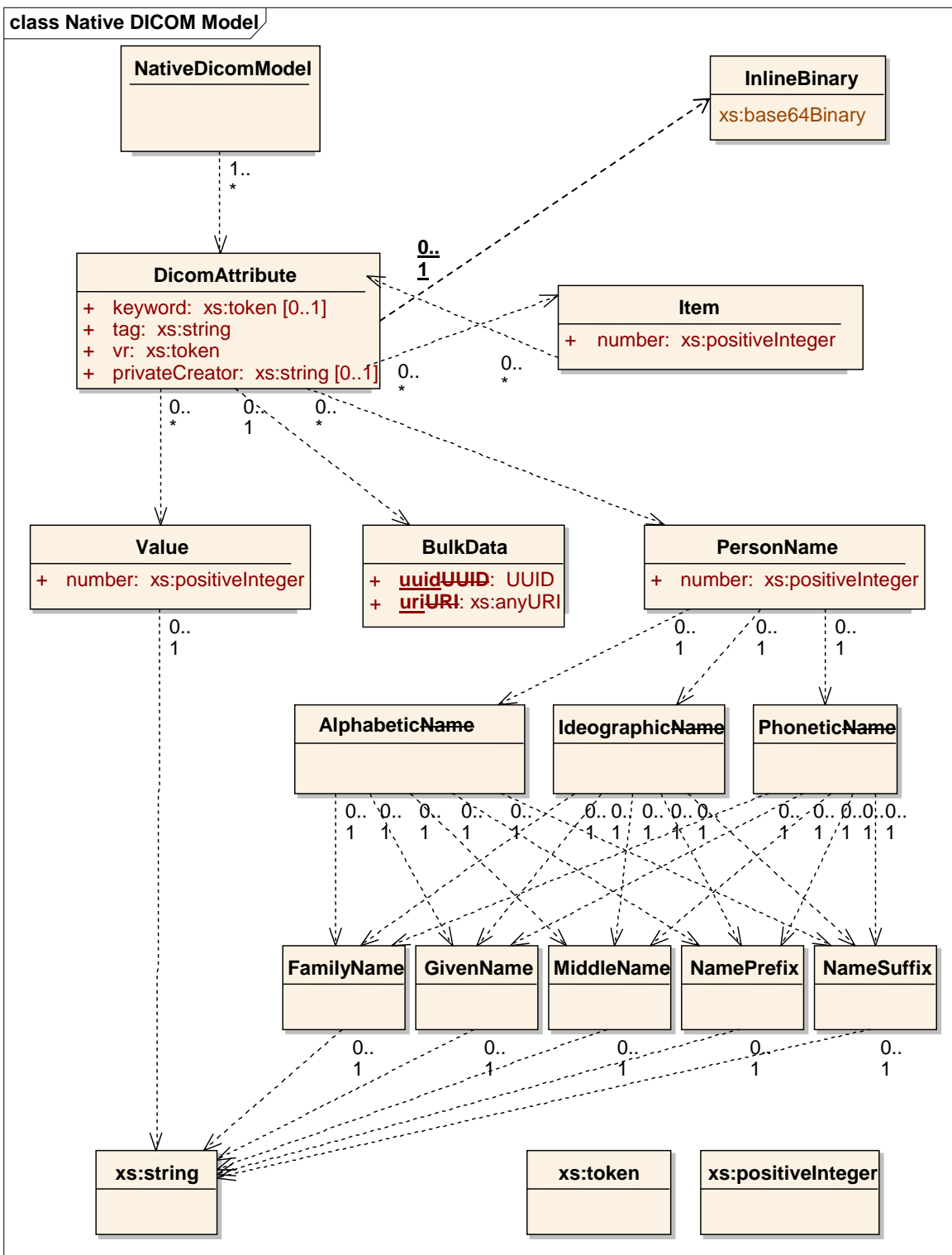
**Group Length (gggg,0000) attributes shall not be included in a Native DICOM Model instance.**

1218 A data recipient that converts data from an instance of the Native DICOM Model back into a binary  
encoded DICOM object shall adjust the padding as necessary to meet the encoding rules specified in  
1220 DICOM PS3.5.

**Update PS 3.19 A.1.4 Information as shown below.**

#### 1222 A.1.4 Information Model

A diagram of the Native DICOM Model appears in Figure A.1.4-1.



1224

1226

**Table A.1.5-2 DICOM Data Set Macro**

| Name                           | Optionality | Cardinality | Description   |
|--------------------------------|-------------|-------------|---|
| DicomAttribute                 | O           | 0-n         | An Infoset element corresponding to each DICOM Attribute.   |
| >keyword                       | C           | A           | <p>The keyword as defined in PS3.6.</p> <p>Required unless the DICOM Data Element is unknown to the host.</p>   |
| >tag                           | R           | A           | <p>The four-digit zero-padded hexadecimal values of the Group and Element Numbers of the Data Element Tag, concatenated as a single string without a delimiter <b><u>and with lowercase letters disallowed</u></b>. E.g., Data Element (0010,0020) would have a tag of "00100020".</p> <p>For Private Data Elements, the two most significant hexadecimal characters of the Element Number shall be 00, since the Private Creator is explicitly conveyed and the block used in the DICOM encoding shall not be sent (i.e., a Private Data Element has the form gggg00ee).</p> |
| ...                            |             |             |   |
| >Value                         | C           | 1-n         | <p>A Value from the Value Field of the DICOM Data Element. There is one Infoset Value element for each DICOM Value or Sequence Item.</p> <p>Required if the DICOM Data Element represented is not zero length and an Item, PersonName, or BulkData XML element is not present. Shall not be used if the VR of the enclosing Attribute is either SQ or PN.</p>   |
| >>number                       | R           | A           | <p>The order in which the Value occurs within the DICOM Value Field, as a number monotonically increasing starting from 1 by 1.</p> <p>Note: The Number XML Attribute is used to preserve the original order.</p>   |
| >> <i>plain character data</i> | C           | 1           | <p>A single DICOM value encoded as plain character data.</p> <p>E.g., a DICOM Decimal String Value Field that contained two delimiter-separated</p>   |

|           |   |   |   |
|-----------|---|---|---|
|           |   |   | <p>values, e.g., “0.5\0.4” would be encoded as two Infoset Value elements:</p> <pre>&lt;Value number="1"&gt;0.5&lt;/Value&gt; &lt;Value number="2"&gt;0.4&lt;/Value&gt;</pre> <p>A Code String Value Field that containing three delimiter-separated values, the second of which was zero length, “MPG\XR3”, would be encoded as:</p> <pre>&lt;Value number="1"&gt;MPG&lt;/Value&gt; &lt;Value number="2"&gt;&lt;/Value&gt; &lt;Value number="3"&gt;XR3&lt;/Value&gt;</pre> <p>Contrast the latter example with a zero length Value Field, in which case there would be no Infoset Value elements at all.</p> <p><b><u>For DICOM Data Elements whose VR is AT, each value shall be encoded as the four-digit zero-padded hexadecimal values of the Group and Element Numbers of the Data Element Tag, concatenated as a single string without a delimiter and with lowercase letters disallowed.</u></b></p> <p>The character encoding is that declared for the Infoset, regardless of any DICOM Specific Character Set, and any necessary translation from the DICOM Specific Character Set to the Infoset character encoding shall have been performed.</p> <p>Note: This translation might not be completely lossless, particularly with Asian character sets.</p> |
| ...       |   |   |   |
| >BulkData | C | 1 | <p>A reference to a blob of data that the recipient may retrieve through use of the GetData() method, a WADO-RS call, or a STOW-RS call.</p> <p>Required if the DICOM Data Element represented is not zero length and an XML Infoset Value, Item, InlineBinary, or PersonName element is not present.</p> <p>The provider of the data may use a BulkData reference at its discretion to avoid encoding a large DICOM Value</p>  |

|                     |   |   |  |
|---------------------|---|---|--|
|                     |   |   | <p>Field by value in the Infoset, for example, pixel data or look up tables.</p> <p>There is a single BulkData Infoset element representing the entire Value Field, and not one per Value in the case where the Value Multiplicity is greater than one. E.g., a LUT with 4096 16 bit entries that may be encoded in DICOM with a Value Representation of OW, with a VL of 8192 and a VM of 1, or a US VR with a VL of 8192 and a VM of 4096 would both be represented as a single BulkData element.</p> <p>All rules (e.g. byte ordering and swapping) in DICOM PS 3.5 apply.</p> <p>Note: Implementers should in particular pay attention the PS 3.5 rules regarding the value representations of OW and OF.</p> <p>If the BulkData has a string or text Value Representation, the value(s) of the DICOM Specific Character Set Data Element, if present, might be necessary to determine its encoding.</p> |
| >> <u>uuid</u> UUID | C | A | <p>An identifier of this bulk data reference formatted as a UUID using the hexadecimal representation defined in ITU-T Recommendation X.667.</p> <p>Required if BulkData URI is not present. Shall not be present otherwise.</p>   |
| >> <u>uri</u> URI   | C | A | <p>The HTTP(S) URI for this bulk data reference.</p> <p>Required if the NativeDicomModel was:</p> <ul style="list-style-type: none"> <li>- returned in response to a WADO-RS Retrieve Metadata request</li> </ul> <p>Shall not be present otherwise.</p>   |

**Update PS 3.19 A.1.6 Schema as shown below.**

1228 **A.1.6 Schema**

The Normative version of the XML Schema for the Native DICOM Model follows:

1230 default namespace="http://dicom.nema.org/PS3.19/models/NativeDICOM"

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```
1232 # This schema was created as an intermediary, a means of describing
1233 # native binary encoded DICOM objects as XML Infosets, thus allowing
1234 # one to manipulate binary DICOM objects using familiar XML tools.
1235 # As such, the schema is designed to facilitate a simple, mechanical,
1236 # bi-directional translation between binary encoded DICOM and XML-like
1237 # constructs without constraints, and to simplify identifying portions
1238 # of a DICOM object using XPath statements.
1239 #
1240 # Since this schema has minimal type checking, it is neither intended
1241 # to be used for any operation that involves hand coding, nor to
1242 # describe a definitive, fully validating encoding of DICOM concepts
1243 # into XML, as what one might use, for example, in a robust XML
1244 # database system or in XML-based forms, though it may be used
1245 # as a means for translating binary DICOM Objects into such a form
1246 # (e.g. through an XSLT script).

1248 start = element NativeDicomModel { DicomDataSet }

1250 # A DICOM Data Set is as defined in PS3.5. It does not appear
1251 # as an XML Element, since it does not appear in the binary encoded
1252 # DICOM objects. It exists here merely as a documentation aid.
DicomDataSet = DicomAttribute*
1254
DicomAttribute = element DicomAttribute {
1256   Tag, VR, keyword?, PrivateCreator?,
   ( BulkData | Value+ | Item+ | PersonName+ | InlineBinary )?
1258 }
BulkData = element BulkData{ (UUID | URI) }
1260 Value = element Value { Number, xsd:string }
InlineBinary = element InlineBinary { xsd:base64Binary }
1262 Item = element Item { Number, DicomDataSet }
PersonName = element PersonName {
1264   Number,
   element AlphabeticSingleByte { NameComponents }?,
1266   element Ideographic { NameComponents }?,
   element Phonetic { NameComponents }?
1268 }

1270 NameComponents =
   element FamilyName {xsd:string}?,
1272   element GivenName {xsd:string}?,
   element MiddleName {xsd:string}?,
1274   element NamePrefix {xsd:string}?,
   element NameSuffix {xsd:string}?
1276
# keyword is the attribute tag from PS3.6
1278 # (derived from the DICOM Attribute's name)
Keyword = attribute keyword { xsd:token }
1280 # canonical XML definition of Hex, with lowercase letters disallowed
Tag = attribute tag { xsd:string{ minLength="8" maxLength="8" pattern="[0-9A-F]{8}" } }
1282 VR = attribute vr { "AE" | "AS" | "AT" | "CS" | "DA" | "DS" | "DT" | "FL" | "FD"
   | "IS" | "LO" | "LT" | "OB" | "OF" | "OW" | "PN" | "SH" | "SL"
1284   | "SQ" | "SS" | "ST" | "TM" | "UI" | "UL" | "UN" | "US" | "UT" }
PrivateCreator = attribute privateCreator{ xsd:string }
1286 UUID = attribute uuid { xsd:string }
URI = attribute uri { xsd:anyURI }
1288 Number = attribute number { xsd:positiveInteger }
```