

## DICOM Correction Proposal

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Correction Number	CP 1536
Log Summary:	Add support for HTTP/2 to Web Services
Name of Standard	PS3.18

Rationale for Correction: HTTP/2 is now an accepted standard that can significantly improve the performance of RS (RESTful) Service. The HTTP/2 standards says:

*This specification describes an optimized expression of the semantics of the Hypertext Transfer Protocol (HTTP), referred to as HTTP version 2 (HTTP/2). HTTP/2 enables a more efficient use of network resources and a reduced perception of latency by introducing header field compression and allowing multiple concurrent exchanges on the same connection. It also introduces unsolicited push of representations from servers to clients.*

*This specification is an alternative to, but does not obsolete, the HTTP/1.1 message syntax. HTTP's existing semantics remain unchanged.*

And

HTTP/2 supports all of the core features of HTTP/1.1 but aims to be more efficient in several ways.

And

*Extensions that could change the semantics of existing protocol components MUST be negotiated before being used. For example, an extension that changes the layout of the HEADERS frame cannot be used until the peer has given a positive signal that this is acceptable.*

And

*HTTP/2 is intended to be as compatible as possible with current uses of HTTP. This means that, from the application perspective, the features of the protocol are largely unchanged. To achieve this, all request and response semantics are preserved, although the syntax of conveying those semantics has changed.*

From High Performance Browser Networking:

*HTTP/2 does not modify the application semantics of HTTP in any way. All of the core concepts, such as HTTP methods, status codes, URIs, and header fields, remain in place. Instead, HTTP/2 modifies how the data is formatted (framed) and transported between the client and server, both of whom manage the entire process, and hides all the complexity from our applications within the new framing layer. As a result, all existing applications can be delivered without modification. That's the good news.*

And

*Why not HTTP/1.2?*

*To achieve the performance goals set by the HTTP Working Group, HTTP/2 introduces a new binary framing layer that is not back-ward compatible with previous HTTP/1.x servers and clients. Hence the major protocol version increment to HTTP/2.*

*That said, unless you are implementing a web server or a custom client by working with raw TCP sockets, you won't see any difference: all the new, low-level framing is performed by the client and server on your behalf. The only observable differences will be improved performance and availability of new capabilities like request prioritization, flow control, and server push!*

And

The HTTP/2 standard does not require use of TLS, but in practice it is the most reliable way to deploy a new protocol in the presence of large number of existing intermediaries<sup>13</sup>. As a result, the use of TLS and ALPN is the recommended mechanism to deploy and negotiate HTTP/2: the client and server negotiate the desired protocol as part of the TLS handshake without adding any extra latency or round-trips<sup>14</sup>. Further, as an additional constraint, while all popular browsers have committed to supporting HTTP/2 over TLS, some have also indicated that they will only enable HTTP/2 over TLS—e.g., Firefox and Google Chrome. As a result, TLS with ALPN negotiation is a de-facto requirement for enabling HTTP/2 in the browser.

*Updating RESTful Services to support HTTP/2 should have no semantic effect on the Standard. However, it should allow substantially faster transactions.*

Updates:

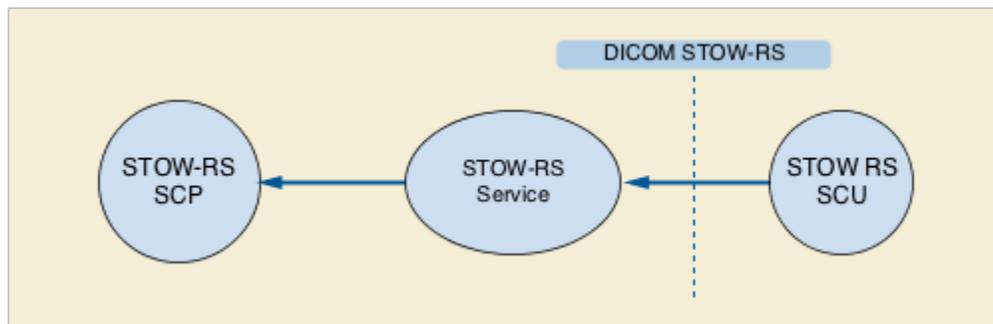
1. HTTP/1.1 -> HTTP in Parts 2, 17, and 18.
2. Add text to beginning of PS3.18 Section 6 specifying that Web Services:
  - a. Supports HTTP and HTTPS versions 1.1 and 2.
  - b. Suggest a preferred method of upgrading a connection from HTTP/1.1 to HTTP/2 with fallback to HTTP/1.1 on failure.

Correction Wording:

5 Update PS3.2 Annex J, Section J.4.1.1 as follows:

### J.4.1.1 Application Data Flow

Example STOW Service



10 **Figure J.4.1-1. Application Data Flow Diagram**

The STOW-RS Service Application receives STOW requests from a remote AE. These requests are ~~HTTP/1.1~~ **HTTP** POST requests. It is associated with the local real-world activity "Store Instances". It converts these requests into internal functions to store the given SOP Instances. It returns a summary HTTP status line, including a status code and an associated textual phase, followed by an XML message indicating success, warning, or failure for each instance to the requesting remote AE.

### J.4.1.2 Functional Definition of AEs

#### J.4.1.2.1 Functional Definition of STOW Service Application

20 The reception of a STOW-RS POST request will activate the STOW-RS Service. The storage request is based upon the accept headers in the STOW-RS POST request. The response includes an ~~HTTP/1.1~~ **HTTP** status line, including a status-code and its associated textual phrase, followed by an XML message indicating success, warning, or failure for each instance stored by the STOW-RS service.

Update PS3.2 Annex J, Section J.4.2.2.4.2 as follows:

#### J.4.2.2.4.2 Number of Connections

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

**Table J.4.2-4. Number of HTTP Requests Supported**

Maximum number of simultaneous RS requests	100 (configurable)
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#### J.4.2.2.4.3 Asynchronous Nature

EXAMPLE-STOW-SERVICE does not support RS asynchronous response.

30 Update PS3.2 Annex J, Section J.4.2.2.4.4 as follows:

#### J.4.2.2.4.4 SOP Specific Conformance for SOP Class(Ees)

The EXAMPLE-STOW-SERVICE response message header contains status codes indicating success, warning, or failure as shown in the ~~HTTP/1.1~~ **HTTP** Standard Response Codes" below. No additional status codes are used.

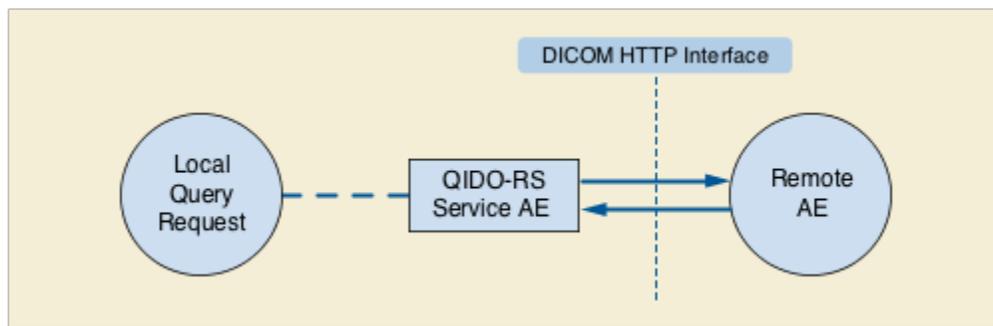
**Table J.4.2.2.4.4-1. HTTP/1.1 Standard Response Codes**

35

Service Status	HTTP/1.1 HTTP Status Code	STOW-RS Description
Failure	400 - Bad Request	This indicates that the STOW-RS Service was unable to store any instances due to bad syntax.
	401 - Unauthorized	This indicates that the STOW-RS Service refused to create or append any instances because the client is not authenticated.

*Update PS3.2 Annex K.4.1.1 as follows:*

**K.4.1.1 Application Data Flow**



40

**Figure K.4.1-1. Application Data Flow Diagram**

The QIDO-RS Provider Application receives QIDO requests from a remote AE. These requests are ~~HTTP/1.1~~ **HTTP** GET requests. It is associated with the local real-world activity "Query Remote Device". It uses 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.

45

*Update PS3.2 Annex K.4.2.1.4.2 as follows:*

**K.4.2.1.4.2 Number of Connections**

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

50

**Table K.4.2-4. Number of ~~HTTP/1.1~~ HTTP Requests Supported**

Maximum number of simultaneous RS requests	100 (configurable)
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...

*Update PS3.2 Annex K.4.2.1.4.4 as follows:*

**K.4.2.1.4.4 Response Status**

55

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

**Table K.4.2-5. ~~HTTP/1.1~~ HTTP 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.

60 *Update PS3.17 Annex HHH.1.2.4as follows:*

### HHH.1.2.4 STOW-RS

The STOW-RS Service provides the ability to STore Over the Web using RESTful Services (i.e., ~~HTTP/4.4~~ HTTP based functionality equivalent to C-Store).

- 65 • For the "DICOM Creator", one or more multipart/related parts are stored (posted to a STOW-RS Service) containing one or more DICOM Composite SOP Instances.
- For the "Metadata and Bulk Data Creator", one or more multipart/related parts are stored (posted to a STOW-RS Service) containing the XML encoded metadata defined in PS3.19 and one or more parts containing the bulk data of a Study, Series or SOP Instance.

70 *Update PS3.17 Annex HHH.2 as follows:*

### HHH.2 Web and Rest Services Implementation

The implementation architecture has to maximize interoperability, preserve or improve performance and minimize storage overhead.

The Web and REST Services technologies have been selected to:

- 75 a. be firewall friendly and supporting security,
- b. be supported by and interoperable between multiple development environments, and
- c. have sufficient performance for both large and small text and for binary data.

80 The XML implementation of the messages uses the CamelCase parameter style used in SOAP 1.2 (element names starting with an upper case character, e.g., ElementOne, attribute names starting with a lower case character e.g., attributeOne).

The WADO-WS response will be provided as list of instances in MTOM/XOP ("DICOM" or "Rendered" Requesters), XML encoded additional information resulting from the XPath filters applied on every objects selected ("Information Requester")

85 The WADO-RS response will be provided as a list of XML and/or binary instances in a multipart/related response. The type of response depends on the media types listed in the Accept header.

The STOW-RS response is a standard ~~HTTP/4.4~~ **HTTP** status line and possibly an XML response message body. The meaning of the success, warning, or failure statuses are defined in PS3.18.

*Update PS3.17 Annex HHH.3.3.9 and HHH.3.3.10 as follows:*

### 90 **HHH.3.3.9 DICOM Creator**

- A. The requesting system is an application capable of making ~~HTTP/4.4~~ **HTTP** Service requests and able to process data encoded as PS3.10 binary instances.
- B. The request specifies
  - 1. The STOW-RS Service to store POST requests.
  - 95 2. Optionally, it may also specify Study Instance UID indicating all POST requests are for the indicated study.
  - 3. SOP Instances, per DICOM PS3.10 encoding.
- C. The response is a standard ~~HTTP/4.4~~ **HTTP** status line and an XML response message body. The meaning of the success, warning, or failure statuses are defined in PS3.18.

### **HHH.3.3.10 Metadata and Bulk Data Creator**

- 100 A. The requesting system is an application capable of making ~~HTTP/4.4~~ **HTTP** requests and able to process data encoded as PS3.19 XML metadata.
- B. The request specifies
  - 1. The STOW-RS Service to store POST requests.
  - 2. Optionally, it may also specify Study Instance UID indicating all POST requests are for the indicated study.
  - 105 3. XML metadata, per DICOM PS3.19 encodings, and bulk data.
- C. The response is a standard ~~HTTP/4.4~~ **HTTP** status line and an XML response message body. The meaning of the success, warning, or failure statuses are defined in PS3.18.

*Insert the following at the appropriate place in PS3.18, Section 3:*

110 **IETF RFC 7540 Hypertext Transfer Protocol Version 2 (HTTP/2)**  
<https://tools.ietf.org/html/rfc7540#section-3>

*Insert the following at the appropriate place in PS3.18, Section 4:*

## **4.7 HTTP**

115 **The term HTTP as used in this Standard means the HyperText Transport Protocol versions 1.1 or 2.**

## **4.7 HTTPS**

**The term HTTPS as used in this Standard means the HyperText Transport Protocol versions 1.1 or 2.**

120 *Update the following at the appropriate place in PS3.18, Section 5:*

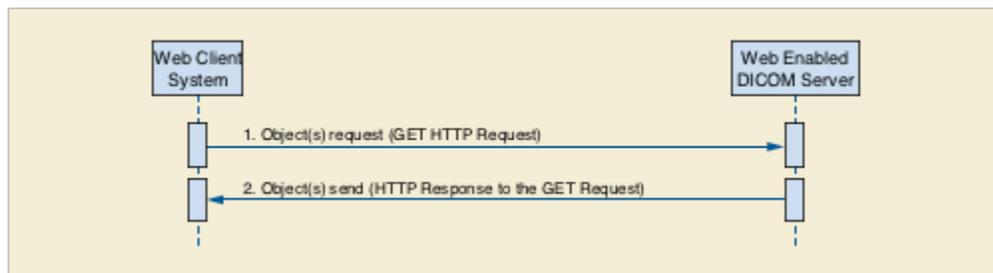
~~HTTPs~~ **HTTPS** HyperText Transfer Protocol, ~~secured~~ **Secured**

## 6 Data Communication Requirements

125 **DICOM Web Services use the HTTP and HTTPS protocols as its transport medium. Web Services supports both version 1.1 and 2 of the protocol. If an origin server supports version 2, it shall also support version 1.1.**

130 **It is recommended that user agents that want to use HTTP/2, first initiate an HTTP/1.1 connection to the origin server and then upgrade to HTTP/2. If the upgrade fails then the user agent can still use the HTTP/1.1 connection. [RFC7540, Section 3 <<https://tools.ietf.org/html/rfc7540#section-3>>] explains how to initiate as HTTP/2 connections.**

### 6.1 Interaction



135 **Figure 6-1. Interaction Diagram**

### 6.6 STOW-RS Request/Response

The STOW-RS Service defines one action type. An implementation shall support the following action type:

140 1. Store Instances

This action creates new resources for the given SOP Instances on the Server or appends to existing resources on the Server.

All request messages are ~~HTTP/1.1~~ **HTTP** multipart messages. The organization of SOP Instances into message parts depends on whether the SOP Instances are structured as PS3.10 binary instances, or metadata and bulk data.

145 PS3.10 binary instances shall be encoded with one message part per DICOM Instance.

Metadata and bulk data requests will be encoded in the following manner:(see Figure 6.5-1 Mapping between IOD and HTTP message parts):

- All XML request messages shall be encoded as described in the Native DICOM Model defined in PS3.19 with one message part per XML object.
- 150 • All JSON requests shall be encoded as an array of DICOM JSON Model Objects defined in Annex F.
- Uncompressed bulk and pixel data shall be encoded in a Little Endian format using the application/octet-stream media type with one message part per bulk data item.
- Compressed pixel data shall be encoded in one of two ways:
  - Single-frame pixel data encoded using a single-frame media type (one message part)
  - 155 • Multi-frame or video pixel data encoded using a multi-frame media type (multiple frames in one message part)

Compressed pixel data shall be encoded using the Media Types as described in Table 6.5-1 WADO-RS Media Type Mapping to Transfer Syntax UID. Media Types corresponding to several DICOM Transfer Syntax UIDs may require a transfer-syntax parameter to disambiguate the request.

160 HTTP Request field Content-Type is used in the header lines by the client in an **HTTP/1.1 HTTP** transaction to indicate the type of data being sent to the Service. All lines are RFC822 or RFC7230 format headers. All HTTP header fields whose use is not defined by STOW-RS shall have the meaning defined by the HTTP standard.

The Service is required to support uncompressed bulk and pixel data (multipart/related; type= application/octet-stream).

165 Update PS3.18, Table 6.6.1-1 as follows::

**Table 6.6.1-1. HTTP/1.1 HTTP Standard Response Code**

Service Status	HTTP/1.1 HTTP Status Codes	STOW-RS Description
Failure	400 - Bad Request	This indicates that the STOW-RS Service was unable to store any instances due to bad syntax.
	401 - Unauthorized	This indicates that the STOW-RS Service refused to create or append any instances because the client is not authorized.
	403 - Forbidden	This indicates that the STOW-RS Service understood the request, but is refusing to fulfill it (e.g., an authorized user with insufficient privileges).
	409 - Conflict	This indicates that the STOW-RS Service request was formed correctly but the service was unable to store any instances due to a conflict in the request (e.g., unsupported SOP Class or StudyInstanceUID mismatch).  This may also be used to indicate that a STOW-RS Service was unable to store any instances for a mixture of reasons.  Additional information regarding the instance errors can be found in the XML response message body.
	415 - Unsupported Media Type	This indicates that the STOW-RS Service does not support the Content-Type specified in the storage request (e.g., the service does not support JSON metadata).
	503 - Busy	This indicates that the STOW-RS Service was unable to store any instances because it was out of resources.
Warning	202 - Accepted	This indicates that the STOW-RS Service stored some of the instances but warnings or failures exist for others.  Additional information regarding this error can be found in the XML response message body.
Success	200 - OK	This indicates that the STOW-RS Service successfully stored all the instances.

Update PS3.18, Section 6.7.1.2 as follows:

170 **6.7.1.2 Response**

The Server shall perform the query indicated in the request. The Server shall return the query results or, 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 {maximumResults} is the lesser of the number of matching results and the maximum number of results supported by the Server.

175 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 result number ({skippedResults} + {maximumResults}). If ({skippedResults} + 1) exceeds {maximumResults} then no results are returned.

180 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/4.4 HTTP** Warning header (see RFC 7230 Section 14.46):

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

Note

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

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.

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

### 6.7.1.2.1 Matching

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

195 Matching results shall be generated according to the Hierarchical Search Method described in Section C.4.1.3.1.1 in PS3.4.

Combined Datetime matching shall be performed (see Section C.2.2.2.5 in PS3.4).

Note

200 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

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.

205 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.

If the "fuzzymatching=true" query key/value is included in the request and it is not supported, the response shall include the following **HTTP/4.4 HTTP** Warning header (see RFC 7230 Section 14.46):

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

210 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.

Note

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

215 

<i>Update PS3.18, Section 6.7.1.2.3.1 as follows:</i>
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#### 6.7.1.2.3.1 XML Results

- Content-Type: multipart/related; type=application/dicom+xml

- The response is a multipart message body where each part is a DICOM PS3.19 XML NativeDicomModel element containing the attributes for one matching Study, Series or Instance (see Section A.1 in PS3.19).
- 220
- The provider of the QIDO service may use a BulkData reference at its discretion (see Table A.1.5-2 in PS3.19 and Section 6.5.6). For example, this might be done to avoid encoding a large DICOM Value Field, such as an image thumbnail.
  - If there are no matching results, the message body will be empty.
- Each item in the multipart response will contain the following **HTTP/4.4 HTTP** headers:

- 225
- Content-Type: application/dicom+xml

#### 6.7.1.2.3.2 JSON Results

- Content-Type: application/json
- The response is a DICOM JSON message containing a DICOM JSON property for each matching study, series or instance containing sub-properties describing the matching attributes for each study, series or instance (see Section F.2).
- 230
- The provider of the QIDO service may use a BulkDataURI reference at its discretion (see Section F.2.6). For example, this might be done to avoid encoding a large DICOM Value Field, such as an image thumbnail.
  - If there are no matching results, the JSON message is empty.

235 Update PS3.18, Section 6.7.1.3 as follows:

### 6.7.1.3 Status Codes

Table 6.7-1 lists the **HTTP/4.4 HTTP** 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.

**Table 6.7-1. QIDO-RS HTTP/4.4 HTTP Status Codes**

240

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.

Update PS3.18, Section 6.8.1.3 as follows:

### 6.8.1.3 Status Codes

245 Table 6.8-2 lists the **HTTP/1.1 HTTP** 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.

**Table 6.8-2. Server Options HTTP/1.1 HTTP 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 Server Options Provider was unable to perform the query because the Service Provider cannot understand the query component.
401	Unauthorized	The Server Options Provider refused to perform the query because the client is not authenticated.
403	Forbidden	The Server Options Provider understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
503	Busy	Service is unavailable.

*Update PS3.18, Section 6.9.1.2 as follows:*

250 **6.9.1.2 Behavior**

The Origin-Server shall create and maintain UPS instances as instructed by CreateUPS requests and as specified by the SCP behavior in Section CC.2.5.3 in PS3.4.

The Origin-Server shall return the **HTTP/1.1 HTTP** Status Line applicable to the associated request.

**6.9.1.3 Response**

255 The Origin-Server shall return an **HTTP/1.1 HTTP** response message.

**6.9.1.3.1 Response Status Line**

If the Create request is successful, the Origin-Server shall return an **HTTP/1.1 HTTP** "201 - Created" response code.

If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table 6.9.1-1.

260 **Table 6.9.1-1. Status Codes**

<b>HTTP/1.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
201	Created	The UPS instance was created and the new resource can be retrieved at the Content-Location specified in the response
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).

<b>HTTP/4.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
409	Conflict	The UID of the posted UPS Instance corresponds to an existing UPS Instance.
503	Busy	Service is unavailable.

### 6.9.1.3.2 Response Headers

If the request is successful, the **HTTP/4.1 HTTP** response message shall include the following **HTTP/4.1 HTTP** header:

- 265 • Content-Location: {+WorkitemURL}

Where {+WorkitemURL} is the URL from which the created UPS Instance can be retrieved (see Section 6.9.4)

If the UPS instance was created with modifications, the response message shall include the following **HTTP/4.1 HTTP** header:

- Warning: 299 {+SERVICE}: The UPS was created with modifications.

270

<i>Update PS3.18, Section 6.9.2.2 as follows:</i>
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### 6.9.2.2 Behavior

The Origin-Server shall support the Attribute changes to the UPS instance specified by the User-Agent in the UpdateUPS request and as specified by the SCP behavior in Section CC.2.6.3 in PS3.4.

- 275 The Origin-Server shall return the **HTTP/4.1 HTTP** Status applicable to the associated request.

### 6.9.2.3 Response

The Origin-Server shall return an **HTTP/4.1 HTTP** response message.

#### 6.9.2.3.1 Response Status Line

If the Set request is successful, the Origin-Server shall return an **HTTP/4.1 HTTP** "200 - OK" response code.

- 280 If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table 6.9.2-1.

**Table 6.9.2-1. Status Codes**

<b>HTTP/4.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
200	OK	The UPS instance was updated
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
409	Conflict	The request cannot be performed for one of the following reasons:

<b>HTTP/4.4 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
		<ul style="list-style-type: none"> <li>• the submitted request is inconsistent with the current state of the UPS Instance</li> <li>• the Transaction UID is missing</li> <li>• the Transaction UID is incorrect</li> </ul>
503	Busy	Service is unavailable.

### 6.9.2.3.2 Response Headers

285 If the UPS instance was updated but with modifications made by the Origin-Server, the response message shall include the following **HTTP/4.4 HTTP** header:

- Warning: 299 (+SERVICE): The UPS was created with modifications.

If optional attributes were rejected, the response message shall include the following **HTTP/4.4 HTTP** Warning header field:

- 290
- Warning: 299 (+SERVICE): Requested optional Attributes are not supported.

If the request was rejected with an **HTTP/4.4 HTTP** 409 status code, the response message shall include one of following messages encoded in an **HTTP/4.4 HTTP** Warning header field describing the nature of the conflict:

- Warning: 299 (+SERVICE): The Transaction UID is missing.
- Warning: 299 (+SERVICE): The Transaction UID is incorrect.

- 295
- Warning: 299 (+SERVICE): The submitted request is inconsistent with the current state of the UPS Instance.

<i>Update PS3.18, Section 6.9.3.3 as follows:</i>
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### 6.9.3.3 Response

The Origin-Server shall return an **HTTP/4.4 HTTP** response message.

#### 300 6.9.3.3.1 Response Status Line

If the SearchForUPS request is successful, the Origin-Server shall return an **HTTP/4.4 HTTP** "200 - OK" response code.

If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table 6.9.3-1.

305 **Table 6.9.3-1. Status Codes**

<b>HTTP/4.4 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
200	OK	The query completed and any matching results are returned in the message body.
206	Partial Content	Only some of the query results were returned and the rest can be requested through the appropriate UPS-RS request.
400	Bad Request	The UPS-RS Origin-Server was unable to perform the query because the Service Provider cannot understand the query component.
401	Unauthorized	The UPS-RS Origin-Server refused to perform the query because the client is not authenticated.

<b>HTTP/4.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
403	Forbidden	The UPS-RS Origin-Server 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.
503	Busy	Service is unavailable.

*Update PS3.18, Section 6.9.3.3.1 as follows:*

#### **6.9.3.3.1 XML Response Message**

- 310
- Content-Type:
    - multipart/related; type=application/dicom+xml
  - The response is a multipart message body where each part is a DICOM PS3.19 XML DicomNativeModel element containing the attributes for one matching UPS Instance (see Section A.1 in PS3.19).
  - If there are no matching results, the message body shall be empty.
- 315
- Each part in the multipart body includes the following **HTTP/4.1 HTTP** headers:
    - Content-Type: application/dicom+xml

*Update PS3.18, Section 6.9.4.2 as follows:*

#### **6.9.4.2 Behavior**

- 320 The Origin-Server shall return, via the **HTTP/4.1 HTTP** response, the indicated Unified Procedure Step Instance to the User-Agent.

Note

The requirement for the Origin-Server to respond to GET requests for UPS Instances that have moved to the COMPLETED or CANCELED state is limited. See Section CC.2.1.3 in PS3.4.

- 325 The User-Agent shall not return the Transaction UID (0008,1195) Attribute. This is necessary to preserve this Attribute's role as an access lock.

The User-Agent shall return the **HTTP/4.1 HTTP** Response Status Code applicable to the associated request. A Failure Code shall indicate that the Origin-Server has not returned the SOP Instance.

330 *Update PS3.18, Section 6.9.4.3 as follows:*

#### **6.9.4.3 Response**

The Origin-Server shall return an **HTTP/4.1 HTTP** response message.

##### **6.9.4.3.1 Response Status Line**

If the Retrieve request is successful, the Origin-Server shall return an **HTTP/4.1 HTTP** "200 - OK" response code.

- 335 If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table 6.9.4-1.

**Table 6.9.4-1. Status Codes**

<b>HTTP/1.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
200	OK	The requested instance is returned.
400	Bad Request	The UPS-RS Origin-Server was unable to perform the query because the Service Provider cannot understand the query component.
401	Unauthorized	The UPS-RS Origin-Server refused to perform the query because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
503	Busy	Service is unavailable.

340 *Update PS3.18, Section 6.9.5.2 as follows:*

### 6.9.5.2 Behavior

The Origin-Server shall support the state changes to the UPS instance specified in the request as described by the SCP behavior in Section CC.2.1.3 in PS3.4.

345 After completing the ChangeUPSState request, the Origin-Server shall return the **HTTP/1.1 HTTP** Response Line applicable to the associated request.

*Update PS3.18, Section 6.9.5.3 as follows:*

### 6.9.5.3 Response

The Origin-Server shall return an **HTTP/1.1 HTTP** response message.

#### 350 6.9.5.3.1 Response Status Line

If the State Change was successful, the Service shall return an **HTTP/1.1 HTTP** "200 - OK" response code.

If the State Change fails, the Service shall return an appropriate failure status line with a response code from Table 6.9.5-1.

**Table 6.9.5-1. Status Codes**

355

<b>HTTP/1.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
200	OK	The UPS instance was updated
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.

<b>HTTP/4.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
409	Conflict	The request cannot be performed for one of the following reasons: <ul style="list-style-type: none"> <li>• the submitted request is inconsistent with the current state of the UPS Instance</li> <li>• the Transaction UID is missing</li> <li>• the Transaction UID is incorrect</li> </ul>
503	Busy	Service is unavailable.

### 6.9.5.3.2 Response Headers

If the User-Agent specifies a Procedure Step State (0074,1000) attribute with a value of "CANCELED" and the UPS Instance is already in that state, the response message shall include the following **HTTP/4.1 HTTP** Warning header field:

- 360 • Warning: 299 {+SERVICE}: The UPS is already in the requested state of CANCELED.

If the User-Agent specifies a Procedure Step State (0074,1000) attribute with a value of "COMPLETED" and the UPS Instance is already in that state, the response message shall include the following **HTTP/4.1 HTTP** Warning header field:

- Warning: 299 {+SERVICE}: The UPS is already in the requested state of COMPLETED.

- 365 If the request was rejected with an **HTTP/4.1 HTTP** 409 status code, the response message shall include one of following messages in the **HTTP/4.1 HTTP** Warning header field describing the nature of the conflict:

- Warning: 299 {+SERVICE}: The Transaction UID is missing.
- Warning: 299 {+SERVICE}: The Transaction UID is incorrect.
- Warning: 299 {+SERVICE}: The submitted request is inconsistent with the current state of the UPS Instance.

370

*Update PS3.18, Section 6.9.6.2 as follows:*

### 6.9.6.2 Behavior

- 375 RequestUPSCancellation is used to request to the Origin-Server that the state of a UPS Instance be changed to CANCELED as shown in Figure CC.1.1-1 in PS3.4. The Origin-Server shall process the request as described by the SCP behavior in Section CC.2.2.3 in PS3.4.

The request may include a Reason For Cancellation and/or a proposed Procedure Step Discontinuation Reason Code Sequence.

The request may also include a Contact Display Name and/or a Contact URI for the person with whom the cancel request may be discussed.

- 380 Note

An **HTTP/4.1 HTTP** Status Code indicating success means that the Request was accepted, not that the UPS has been canceled. The system performing the UPS is not obliged to honor the request to cancel and in some scenarios, may not even receive notification of the request. See Section CC.2.4 in PS3.4.

- 385 To cancel an IN PROGRESS UPS that the User-Agent is itself performing, the User-Agent shall instead use the ChangeUPSState action as described in Section 6.9.5.

*Update PS3.18, Section 6.9.6.3 as follows:*

### 6.9.6.3 Response

The Origin-Server shall return an ~~HTTP/4.4~~ HTTP response message.

### 390 6.9.6.2.1 Response Status Line

If the cancel request was accepted, the Service shall return an ~~HTTP/4.4~~ HTTP "202 - Accepted" response code.

If the cancel request was rejected, the Service shall return an appropriate failure status line with a response code from Table 6.9.6-1.

**Table 6.9.6-1. Status Codes**

395

<del>HTTP/4.4</del> <u>HTTP</u> Code	Reason Phrase	Description
202	Accepted	The cancel request was accepted
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
409	Conflict	The cancellation request is inconsistent with the current state of the UPS Instance
503	Busy	Service is unavailable.

### 6.9.2.5.2 Response Headers

If the UPS Instance is already in a canceled state, the response message shall include the following ~~HTTP/4.4~~ HTTP Warning header field:

- Warning: 299 {+SERVICE}: The UPS is already in the requested state of CANCELED.

400

*Update PS3.18, Section 6.9.7.2 and 6.9.7.3 as follows:*

### 6.9.7.2 Behavior

The Origin-Server shall support the management of UPS instance subscriptions as specified by the SCP behavior in Section CC.2.3.3 in PS3.4.

405 Upon receipt of the CreateSubscription, SuspendGlobalSubscription or DeleteSubscription request, the Origin-Server shall attempt to update the Global Subscription State, Filtered Global Subscription and/or UPS Subscription State of the specified Application Entity with respect to the specified SOP Instance UID as described in Table CC.2.3-2 in PS3.4 and then return the appropriate ~~HTTP/4.4~~ HTTP response.

### 6.9.7.3 Response

#### 410 6.9.7.3.1 Response Status Line

The Service shall return an ~~HTTP/4.4~~ HTTP status line, including a status code and associated reason phrase.

If the CreateSubscription request was successful, the Service shall return an "~~HTTP/4.4~~ HTTP 201 - Created" response code. The response shall contain a "Content-Location" header of the following format:

- Content-Location: {WSSERVICE}

415 where:

- {WSSERVICE} is the base URL for the WebSocket service. This shall include the WebSocket protocol (either WS or WSS) and may include a combination of authority and path.

If the subscription fails, the Service shall return an appropriate failure status line with a response code from Table 6.9.7-2.

420

**Table 6.9.7-2. Status Codes**

<b>HTTP/1.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
201	Created	The subscription was created.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., the Origin-Server does not support global subscription filtering or an authenticated user has insufficient privileges).
404	Not found	The specified UPS Instance or well-known UID does not exist or is not managed by this Origin-Server.
409	Conflict	Specified action not appropriate for specified instance.
503	Busy	Service is unavailable.

**6.9.7.3.2 Response Headers**

If the CreateSubscriptionrequest was accepted but the deletion lock was not, the response message shall include the following HTTP/1.1 Warning header field:

- 425
- Warning: 299 {+SERVICE}: Deletion Lock not granted.

If the request was rejected with an **HTTP/1.1 HTTP** 403 status code because Filtered Global Subscription is not supported, the response message shall include the following **HTTP/1.1 HTTP** Warning header field:

- Warning: 299 {+SERVICE}: The Origin-Server does not support Global Subscription Filtering.

430 Update PS3.18, Section 6.9.8.3.1 as follows:

**6.9.8.3.1 Response Status Line**

The Service shall return an **HTTP/1.1 HTTP** status line, including a status code and associated reason phrase.

If the SuspendGlobalSubscriptionrequest was successful, the Service shall return an **HTTP/1.1 HTTP** "200 - OK" response code.

- 435
- If the subscription change fails, the Service shall return an appropriate failure status line with a response code from Table 6.9.8-1.

**Table 6.9.8-1. Status Codes**

<b>HTTP/1.1 HTTP Code</b>	<b>Reason Phrase</b>	<b>Description</b>
200	OK	The subscription was suspended.

...

440 Update PS3.18, Section 6.9.9.3 as follows:

### 6.9.9.3 Response

#### 6.9.9.3.1 Response Status Line

The Service shall return an ~~HTTP/1.1~~ HTTP status line, including a status code and associated reason phrase.

445 If the DeleteSubscriptionrequest was successful, the Service shall return an ~~HTTP/1.1~~ HTTP "200 - OK" response code.

If the subscription fails, the Service shall return an appropriate failure status line with a response code from Table 6.9.7-1.

**Table 6.9.7-1. Status Codes**

<del>HTTP/1.1</del> <u>HTTP</u> Code	Reason Phrase	Description
200	OK	The subscription was removed.

450 ...

Update PS3.18, Section 6.9.10.3 as follows:

### 6.9.10.3 Response

#### 6.9.10.3.1 Response Status Line

The Service shall return an ~~HTTP/1.1~~ HTTP status line, including a status code and associated reason phrase.

455 If the request was successful, the Service shall return an ~~HTTP/1.1~~ HTTP "101 - Switching Protocols" response code.

If the request fails, the Service shall return an appropriate failure status line with a response code from Table 6.9.10-1.

**Table 6.9.10-1. Status Codes**

<del>HTTP/1.1</del> <u>HTTP</u> Code	Reason Phrase	Description
101	Switching Protocols	The WebSocket connection was established.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g., an authenticated user with insufficient privileges).
503	Busy	Service is unavailable.

460